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In Cooperation with the Texas Agricultural Experiment Station

SOIL SURVEY
OF
NACOGDOCHES COUNTY, TEXAS

BY

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and E. H. TEMPLIN
Texas Agricultural Experiment Station

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SOIL SURVEY OF NACOGDOCHES COUNTY, TEXAS

By B. H. HENDRICKSON, in Charge, and R. E. DEVEREUX, U. S. Department of Agriculture, and E. H. TEMPLIN, Texas Agricultural Experiment Station

COUNTY SURVEYED

Nacogdoches County is in the east-central part of Texas. Angelina River forms the western and southern boundaries of the county and Attoyac Bayou the eastern. The county is roughly triangular in shape and includes a land area of 978 square miles, or 625,920 acres. Its longest east-west dimension is 36 miles, and the longest north-south dimension is 43 miles.

Nacogdoches County is well drained, is rolling or hilly, and is largely in timber. The county consists of a plain well dissected by shallow flat-bottomed valleys.

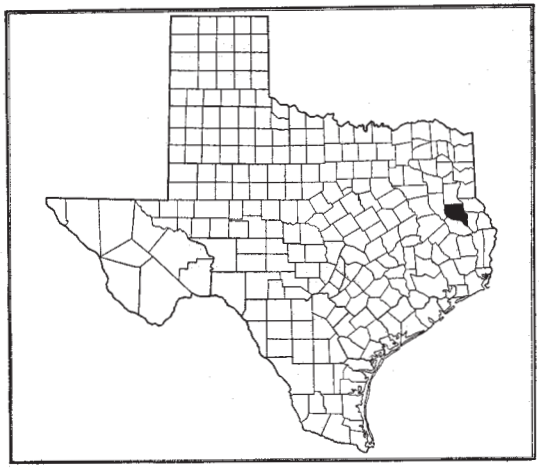

FIGURE 1.—Sketch map showing location of Nacogdoches County, Tex.

The county ranges in elevation from about 250 feet in the lowest river bottoms to about 575 feet on the tops of the highest hills. The elevations of several towns are as follows: Cushing, in the northwestern part, 414 feet; Garrison, in the northeastern part, 380 feet; Mahl, in the north-central part, 523 feet; and Nacogdoches, in the central part, 271 feet. The highest points in the county are in the north-central part, and the lowest are in the southeastern corner at the junction of Attoyac Bayou and Angelina River.

Nacogdoches County is drained by Angelina River and Attoyac Bayou and their tributaries, the largest of which are Loco and Naconiche Creeks. A very well-established dendritic drainage system reaches practically all parts of the county. Good surface drainage prevails throughout the county, except in a very few isolated, small, unimportant flat or depressed areas. The main valleys range from 150 to 200 feet in depth. The rivers and larger creeks are rather sluggish, and their channels meander through wide, flat flood plains.

The rougher lands of the county are in the northwestern part, toward the Angelina River bottoms, where there are several promi-

nent hills, locally called mountains. In the southern part of the county, in the wooded uplands near Angelina River, is another rather large belt of rolling land. The smoother or flatter areas of upland are near Caro and Etoile and in a long, more or less continuous belt paralleling Angelina River from a point near Douglass to Blounts Lake. Another strip of fairly smooth or gently undulating land extends southeast from Chireno for a few miles. In the vicinity of Attoyac there is a small, fairly smooth area.

Nacogdoches County was formed in 1836. At that time it included the territory extending from Sabine River beyond the present site of the city of Dallas. Since then several counties have, at different times. been formed from parts of the original county. Nacogdoches, the county seat, is one of the oldest settlements in Texas. The earliest records indicate that in 1690 a Catholic mission was established under the Spanish rule at the present site of the city. Between 1825 and 1830 an influx of American settlers arrived from various parts of the United States, but chiefly from the Southeastern States. The oldest land grants date from 1792, when the territory was under Spanish dominion. These grants were revalidated under Mexican rule in 1810. All the previous land grants were accepted by the Republic of Texas (1835–1846). About one-half the lands of the county are included in these old land grants. The rest have been surveyed by the Texas Land Office. There are no United States Government lands in Texas.

Previous to the Civil War many large plantations had been established in the Nacogdoches district and farmed by slave labor. The present population is mainly Anglo-American, together with some Spanish, Mexican, and Negro inhabitants. The northern two-thirds of the county is in general the most thickly settled part. The southern part, south of Nacogdoches, Melrose, and Chireno, is only sparsely settled. According to the 1920 census, the population of the county is 28,457, of which 3,546 are classed as urban and 24,911 as rural. Nacogdoches, with a population of 3,546 in 1920, is the county seat and largest town. It is an important lumber and cotton shipping point, local market for agricultural products, and distributing point for merchandise. Cushing, with a population of 1,213, is the second largest town and is the principal shipping point for the northwestern part of the county. Garrison, a town of 603 population, is located in the northeastern part of the county.

Nacogdoches is situated at the junction point of the Houston East & West Texas Railway and the Texas & New Orleans Railroad, both of which belong to the Southern Pacific system. Excellent railroad facilities are thus afforded to the larger markets in all directions. The Houston East & West Texas Railway, the first to be built in the county, reached Nacogdoches from Houston in 1884 and was extended through to Shreveport. In 1900 the Texas & New Orleans Railroad, extending from Dallas to Beaumont, was built through the county. A short line, the Nacogdoches & Southeastern Railroad, was built about 1900 from Nacogdoches through Woden and La Cerda and thence was recently extended in a northeasterly direction into San Augustine County. This railroad has been used mainly for hauling timber. Another short line extends from Caro, on the Texas & New Orleans Railroad, northward to Mount Enterprise,

in Rusk County, providing motor-car service only. A line from Lufkin in Angelina County, the Angelina & Neches River Railroad, reaches Etoile and Chireno. A branch of the St. Louis Southwestern Railway crosses the extreme southern tip of the county.

Five improved, surfaced highways radiate, at the present time, from Nacogdoches to points without the county, and numerous other public roads reach rural settlements within the county. Outlying country roads are poorly kept up and suffer from frequent gullying and washouts. Stretches through areas of plastic clay soils are nearly impassable during continued wet weather, and others, through areas of deep sand, are exceedingly difficult to travel during very dry weather.

Nearly all parts of the county are reached by rural delivery mail service. Telephones are in general use, especially in the better-developed and more thickly settled sections.

The principal home market is Nacogdoches, which consumes a large part of the dairy, vegetable, fruit, meat, and poultry products. Houston, Dallas, Shreveport, and Fort Worth receive most of the agricultural and livestock products shipped from the county.

CLIMATE

The climate of Nacogdoches County is characteristic of the south temperate humid section of the United States. The summers are long and warm and are featured by periods of oppressively high temperature. The winters are short and mild, with short periods of cold or freezing temperatures alternating with spells of warm pleasant weather. Pasture grasses and certain forage crops grow all winter.

The rainfall is ample but may or may not be well distributed throughout the year. The rainfall is lowest during the fall months, when most of the harvesting is done. Winter rains tend to extend over longer periods and are accompanied by more cloudy and unsettled weather than are the rains of the other seasons. Summer rains are more local. They are frequently torrential and do considerable damage by gullying sloping fields and overflowing cultivated bottom lands. The mean annual snowfall is less than one-third inch.

The average date of the last killing frost is March 18 and of the first is November 13. The average frost-free season is 240 days. The latest killing frost on record occurred on April 25 and the earliest on October 21. Late spring and early fall frosts are likely to occur on the bottom lands a week or two after or before, respectively, there is any danger of frost on the uplands.

The climate is favorable to a widely diversified agriculture. Two or more crops may be grown on the same land in one year. Continuous tillage during every month of the year is possible, as the ground rarely freezes. The long grazing season and absence of protracted freezing weather favor livestock raising and dairying. Expensive barns for the shelter of farm animals are not necessary. The early beginning of the growing season in spring makes it possible to produce special vegetable crops and berries for the early markets.

Table 1, giving the normal monthly, seasonal, and annual temperature and precipitation, is compiled from the records of the Weather Bureau station at Nacogdoches.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Nacogdoches*

[Elevation, 271 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year, 1917	Total amount for the wettest year, 1905
	° *F.*	° *F.*	° *F.*	*Inches*	*Inches*	*Inches*
December	48.0	85	11	4.53	0.11	5.86
January	47.9	89	2	2.93	3.79	3.19
February	50.7	98	8	3.82	4.26	3.98
Winter	48.9	98	2	11.28	8.16	13.03
March	59.0	92	21	3.44	1.91	5.62
April	64.6	94	28	4.84	3.27	8.88
May	71.6	97	39	5.38	3.25	8.99
Spring	65.1	97	21	13.66	8.43	23.49
June	79.0	110	48	3.80	.77	5.21
July	81.5	107	57	4.21	5.83	9.43
August	81.8	109	56	2.67	.06	3.69
Summer	80.8	110	48	10.68	6.66	18.33
September	76.4	103	37	3.06	3.74	2.74
October	66.4	96	25	3.09	1.38	1.78
November	57.5	87	16	4.00	.69	10.16
Fall	66.8	103	16	10.15	5.81	14.68
Year	65.3	110	2	45.77	29.06	69.53

AGRICULTURE

Agriculture has been the principal occupation of most of the population of what is now Nacogdoches County from the earliest times. The earliest pioneers cleared small fields in the virgin timber and raised corn, wheat, sweetpotatoes, and vegetables as subsistence crops. Some cattle and hogs were raised on the open range. A start in the raising of cotton and sugarcane was made about 1830, and a gin was established in Nacogdoches in 1833. The first American settlers brought with them horses, cattle, hogs, and equipment and gave a decided impetus to agricultural development.

Cotton had become the important cash crop by 1850, and planting had increased markedly by 1860. With the abolition of slavery in 1865, there came a change from production by slaves to negro croppers or tenants. White tenancy also dates from this period.

The panic of 1873 placed the farmers in a distressing financial condition, as too much reliance had been placed on cotton as a cash crop and means of livelihood and too little attention given to diversification and the production of subsistence crops. A diversified system of farming may be said to date from this period, but the evils of the 1-crop system persist to this day, bringing about both depletion of soil fertility and poverty to the cotton growers.

Under the 1-crop system, fields were planted continuously to cotton until yields became too low to be profitable. New land was then cleared and planted, and the old fields, lying idle, soon reverted to timber by natural reseeding. One-mule farming implements were used for plowing and cultivation, which was almost entirely by the ridge method. This method is still in use in many communities.

The agriculture of the county now consists mainly of the production of cotton as a cash crop and of corn, grain, and forage as feed crops, and of the raising of cattle, hogs, and poultry. There is a tendency toward more diversification, including a more or less definite crop-rotation plan designed to furnish cash crops and sufficient food and feed crops for the maintenance of the farmers' families and their livestock, thereby providing a better distribution of labor, a surer income, and a much better opportunity for maintaining the fertility of the soils. Cotton still remains the principal cash crop of the county, but it is becoming recognized that a reduction of the cotton acreage will allow the growing of other cash crops and the rotation of crops for the purpose of soil improvement. Nearly one-third of the improved land in the county is now devoted to cotton and about one-third to corn. The remainder is planted to numerous crops, including forage crops, sugarcane, sorgo (sweet sorghum), tomatoes, watermelons, and fruits.

The census of 1920 reports that in 1919 cotton occupied 58,589 acres and gave an average yield of less than one-seventh bale to the acre. In 1909, this crop was grown on 40,321 acres and gave an average yield of slightly more than one-fourth bale to the acre. In 1899, it occupied 47,358 acres and produced an average of slightly more than one-third bale to the acre. The actual yields have not decreased so much as these figures seem to indicate. The yield depends to a large extent on the distribution of rainfall during the growing season. In very wet or very dry years yields are low. An average yield of one-fourth or one-third bale to the acre is usually obtained. Nearly all the cotton grown in Nacogdoches County at present is of the Half-and-Half variety. This variety yields fairly well, but the staple is very short. There is a definite trend toward the production of longer-staple varieties, among which are the Acala, Mebane, Kasch, and Rowden Big Boll.

When cotton is grown on the same land for several years in succession, small annual applications of complete fertilizer, cottonseed meal, or superphosphate (acid phosphate) are made. The only rotation commonly practiced consists of cotton one year, followed by corn interplanted with cowpeas or velvetbeans at the last cultivation, one year. In this rotation, the addition of fertilizer in quantities ranging from 150 to 300 pounds is common. The residue from the corn and the leguminous crop supplies such organic matter as the soil receives, either by turning under the cornstalks and vines or by the commoner practice of pasturing the fields with cattle and hogs and turning under the manure. Cattle turned into cotton fields after final picking consume many immature bolls, which may harbor the boll weevil, and thereby aid in weevil control. The boll weevil is usually more destructive to cotton during moist growing seasons and in fields where cotton then makes a rank vegetative growth. To combat the weevil, powdered calcium arsenate is dusted

on the growing plants with hand-blower machines two or three times during the season. The cotton leaf worm and the bollworm are not considered serious pests. They are to some extent controlled by the calcium arsenate powder.

Corn is the crop second in importance. The 1920 census reports 55,925 acres in corn in 1919, when the average yield was 14 bushels to the acre. This has been the approximate average yield for the last 30 years. Corn is strictly a subsistence crop, and all of it is consumed within the county. In addition, considerable quantities are purchased annually from outside markets. The commonest variety of corn grown is the Hastings Prolific. Other varieties grown are the Mosby and native varieties. All types of corn grown are tight husked, as these kinds are less subject to loss on account of grain weevils.

None of the other crops grown occupies, singly, more than one-tenth of the acreage devoted to either cotton or corn. Peanuts, mainly the small Spanish variety, are grown to some extent on the deeper sandy soils of the uplands. The census of 1920 reports 5,583 acres devoted to this crop in 1919, when the yield averaged 13 bushels to the acre. About one-half the peanut crop is gathered and threshed, the nuts being sold to local oil mills; the rest is used principally for hog feed. Oats are grown to some extent on the upland and terrace soils. In 1919 an acreage of 1,631 acres was reported, with a yield of 12 bushels to the acre. Most of the oat crop is utilized as winter pasturage and cut as grain hay the following spring. Red rustproof (Red Texas) is the common variety.

Cowpeas are the principal leguminous crop, after peanuts. The census of 1920 reports 1,728 acres of legumes cut for hay in 1919. It is common practice to plant cowpeas or a similar legume in alternate rows with the corn, when it is 2 or 3 feet high or at the time of the last cultivation. The Iron and Clay are preferred varieties of cowpeas. Sweetpotatoes and yams were grown on 1,384 acres in the same year. These crops are grown on small acreages on almost every farm, for local markets and home consumption. Very few potatoes are grown. Sugarcane was reported on 597 acres in 1919 and sorghum cane on 236 acres. Small patches are ordinarily devoted to these crops for sirup production, for home consumption, and for sale locally. The Red Top or Sumac is the principal variety of sorghum. Watermelons are being grown to an increasing extent on the deeper sandy upland soils. Several carloads have been shipped out of the county annually in recent years. It was estimated that 100 acres or more were planted to early tomatoes in 1925. An extension of tomato growing is expected in the future. Comparatively heavy fertilization is given this crop, from 550 to 800 pounds of complete 4–8–4 [1] or 4–10–4 fertilizer to the acre being used. Side dressings of small amounts of nitrate of soda or sulphate of ammonia are sometimes applied, in addition, to stimulate growth.

The 1920 census reports 1,174 acres of wild and tame grasses cut for hay in 1919. The hay is mainly Johnson grass, which grows on the bottom lands. Bermuda grass is the principal pasture grass, supplemented by carpet and rescue grasses and Lespedeza and bur clover. Some of the sorgo is cut for fodder.

[1] Percentages, respectively, of nitrogen, phosphoric acid, and potash.

There are a few small commercial orchards in the county. More peaches are grown than any other kind of tree fruit, 34,198 peach and nectarine trees being reported by the 1920 census. Pears, plums, figs, and grapes are grown in small orchards on most farms. Native pecan trees are common on both upland and bottom-land soils but are more numerous on the latter. A few small pecan orchards have been planted within the last few years. The culture of small fruits, tree fruits, grapes, and pecans is being stimulated by the marked success in their production experienced in near-by counties in which soil, climatic, and marketing conditions are similar.

The value of all crops in 1919 is given by the census as $3,832,515. The value of cotton and corn represented a large percentage of this total.

In the southern part of the county are large herds of native cattle. A few of the cows are bred to Brahman bulls. Some of the cattle are shipped west for breeding purposes or for crossing with beef breeds. Cattle are shipped direct to Fort Worth stockyards for slaughter. Cattle destined for outside markets are first sent through dipping vats to destroy ticks. Of the dairy breeds, the Jersey is the most popular, and there are many registered animals. There are also a few Holstein. Most of the farm cattle are, however, of mixed, inferior blood and low productive capacity. Country butter is marketed in the towns of the county, and a creamery is at Nacogdoches. A small amount of cream is shipped to Shreveport. There are no cheese factories in the county.

Hogs are the source of considerable income, and well-bred hogs are the rule on the farms. In the southern part of the county there are large numbers of half-wild hogs, which pasture in the woodlands of the river bottoms and fatten on mast. As the hardwood timber has been largely cut out of these stands, the supply of mast has been much reduced. The farmers prefer the Duroc-Jersey and the Poland China breeds of hogs. It is customary to fatten hogs on peanuts and finish them on corn. Most of the hogs are shipped to the stockyards at Fort Worth.

Poultry products from the farms bring in considerable income. Nearly all farmers have a flock of chickens. Rhode Island Red, Barred Plymouth Rock, and Leghorn are favored breeds. Leghorns are preferred for egg production and the American breeds mentioned for general purposes. Many farmers keep small flocks of mixed breeds. The eggs produced above local needs are shipped to Beaumont and Houston. On several poultry farms eggs for hatching are produced. A few Bronze turkeys, some guineas, and a few domestic ducks and geese are also raised.

There are in the county a few small herds of Mexican and grade Angora goats and a few sheep, principally grade Shropshires.

Mules are the preferred work animals on the farms of the county. Very few, however, are raised locally. Fort Worth is the source of supply. Horses are used to some extent for draft purposes but mainly for saddle and driving purposes.

The value of the livestock products of the county in 1919 is given as follows: Animals sold and slaughtered (estimated), $512,107; dairy products, excluding home use, $264,748; poultry and eggs, $252,342; and wool, mohair, and goat hair, $420, totaling $1,029,617.

The agriculture of the county is affected or influenced by the relief, most noticeably in that the steeper, eroded slopes are generally regarded as being unsuited to cultivated crops. In the rolling timbered areas farming is concentrated on the more nearly level or undulating lands, and the woodlands are used for pasture. The proportion of timberland varies, roughly, with the steepness of the slopes. The utilization of bottom lands for cropping purposes is influenced considerably by the position of the lands with reference to overflow. Most of the area of the heavier bottom-land soils is subject to frequent inundation and is utilized for timber and woods pasture. Relief also affects the size of the individual holdings, the hilly, nonagricultural lands usually being owned in large tracts by individuals or lumber companies.

The adaptation of various soils to certain crops is generally recognized. Cotton is grown on practically every tillable soil in the county. The best results are obtained, in average seasons, on the "red lands" of the Nacogdoches and Greenville series. The fine sandy loams with sandy clay subsoils are ordinarily almost as productive, but the deep sands do not ordinarily produce good yields of cotton economically. Although the red and brown bottom-land fine sandy loam and silt loam soils produce the best cotton in dry years, the yield is ordinarily less than on the uplands, owing to damage by overflows, rank vegetative growth, and subsequent tendency to greater boll-weevil infestation. Corn is likewise grown on most soils, but the well-drained bottom lands are preferred. Cowpeas seem to make the best growth on the fine sandy loam upland soils. Peanuts are most successful on the deep upland sands and on deep phases of the fine sandy loams having sandy clay subsoils. Watermelons do best in similar situations. Sugarcane is grown entirely on lower slopes, where colluvial wash has accumulated, or on well-drained bottom lands. A deep sandy soil produces a lighter-colored sirup. Sorghum cane thrives best on similar soils.

The bottom lands furnish the best native pasture and are the most favorable places for establishment of tame pastures. Little attempt has yet been made to improve the pasture lands.

Vegetables are grown on a variety of upland soils, but the well-drained fine sandy loams are recognized as best for the usual garden crops. Tomatoes are grown for the early market on the fine sandy loams of the Nacogdoches and Ruston series.

Peaches do best on the fine sandy loam soils of the Nacogdoches, Greenville, and Orangeburg series but are also grown to some extent on the various Norfolk soils. A better-colored fruit is said to be obtained on friable, easily penetrable, well-oxidized red soils. A few pecan trees have been planted both on well-drained fine sandy loam upland soils and on well-drained bottoms. A better-flavored nut and greater freedom from disease are said to be obtained from trees on the upland soils, although better tree growth and higher yields are obtained from bottom-land orchards.[2]

Although soil and climatic conditions in Nacogdoches County seem to be favorable for the production of high-quality cigar to-

[2] BURKETT, J. H. THE PECAN IN TEXAS. THE STATE TREE. THE PECAN—ITS HISTORY—IMPORTANCE—ECONOMIC VALUE. PECAN STREAMS, SOILS, ORCHARDS, PRODUCTION, INSECTS, DISEASES, GRADES, PROPAGATION, ETC. Tex. Dept. Agr. Bul. 81, 218 p., illus. 1925. [Bul. 77 rev.]

bacco, at present almost no tobacco is grown. Well-drained fine sandy loam soils with friable sandy clay subsoils, such as those of the Greenville, Orangeburg, and Ruston series, produce higher yields than soils of heavier texture, such as Nacogdoches clay loam. The best profits are obtained by making annual applications of 600 pounds cottonseed meal, 400 pounds superphosphate, and 200 pounds sulphate of potash to the acre.

According to the census, the use of commercial fertilizer in quantities worthy of mention began in the present century. The 1900 census reported a total expenditure of $730 for fertilizer in 1899. In 1909, an average of $24.98 a farm was spent for fertilizer, on the 506 farms reporting. In 1919, only 35 farmers reported the purchase of fertilizer, at an expense averaging $49.69 a farm. It is probable that more commercial fertilizer will be used in the future, as the principles of fertilizer practice become more thoroughly understood.

Customarily, cotton receives most of the fertilizer used in the county. Superphosphate alone, in quantities varying from 100 to 200 pounds to the acre, has commonly been applied to cotton lands. Additional small amounts of cottonseed meal or nitrate of soda have been used by many farmers to supplement the superphosphate and provide a better-balanced mixture of plant-food constituents. Many farmers now purchase complete fertilizers for cotton, but until very recently the cheaper and lower grades have had the largest sale. A very popular formula has been the 1.65–10–1 mixture, a cheap fertilizer comparatively low in plant food and unnecessarily high in inert filling materials. Rarely have quantities greater than 250 pounds to the acre been applied to cotton. The tendency is now toward the use of larger amounts of higher-grade mixtures. Lime has not been used as a corrective for acid soil conditions, although practically all the soils of the county, with the exception of the deep sands, have a pronounced acid reaction and a lime requirement of 1 ton or more to the acre.

The 1920 census reports a $329,794 expenditure for farm labor in 1919. There is little floating farm labor, but the supply is usually adequate. The daily wage is about $1.50. Very little labor is hired except at planting, cotton chopping, or harvesting time. Cotton pickers receive from 75 cents to $1.50 a 100 pounds of seed cotton picked. Farm laborers hired by the month receive from $18 to $20, with board.

The 1920 census reports 60 per cent of the area of the county in farms and 48.6 per cent as improved land. The average size of the farms is 96.4 acres. The percentage of farms in the county operated by owners is 52.4 per cent, by tenants is 47.5 per cent, and by managers is 0.1 per cent. The increase in tenancy has been gradual since a reported percentage of 22.2 per cent in 1880.

Land is rarely rented on a cash basis. The common terms of rental are "one-third and one-fourth," meaning that the owner receives one-third of the corn and other crops except cotton, and one-fourth of the cotton. Under this arrangement, the owner furnishes the land and buildings and one-half the fertilizer, and the tenant supplies labor, work animals, seed, and equipment. Some variations of this

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agreement are in use. When land is rented for half the crops, the landlord furnishes everything necessary for farming and the renter supplies only the labor.

The value of land in farms averages $21.92 an acre, according to the census for 1920. The value of farm land depends mainly on location, character and condition of soil, and improvements. Near the shipping points and larger towns, improved farm land is valued at $50 or $60 an acre and unimproved at $10 or $20. The values decrease with increasing distances from towns.

Practically all of Nacogdoches County was originally forested. Small areas of prairie are said to have existed 4 or 5 miles east of Nacogdoches, between Douglass and Cushing, and in a few other places. These areas have at present either been put into cultivation or encroached on by woods. The dominant timber growth and the kind principally converted into merchantable lumber on most of the upland is shortleaf pine, which is known commercially as southern yellow pine. In a few parts of the county, hardwoods and other deciduous trees predominate. Most of the cut-over land tends to revert to pine by natural reseeding, if mother trees are left standing. Post oak, blackjack oak, and scrub oak, and gum and hickory trees, instead of the more desirable pines, grow up in many places in old pastures. A few longleaf pines are in the southern part of the county, and pecan, black walnut, hackberry, and some dogwood, ironwood, prickly ash, and white locust or honeylocust, together with scattered mulberry, holly, and myrtle, are seen. There is a sparse growth of underbrush and woods grasses. On the deep sandy uplands, the shortleaf pine does not grow so rapidly, and turkey oak or sand jack is very common.

The bottom and low moist slopes support a luxuriant tree growth of elm, water oak, bur or overcup oaks, pin and willow oaks, willow beech, maple, ash, and hackberry, together with some black gum and sweetgum, magnolia, bay, sycamore, cottonwood, mulberry, and loblolly or swamp pine. Cypress was formerly present but has been largely cut out. There is a thick undergrowth of Japanese mulberry, pokeberry, hackberry, sumac, and numerous kinds of small brush, weeds, and vines. Other bottom-land trees are cow oak and white oak, bitter pecan or pignut, persimmon, ironwood, and dogwood. Bottom-land grasses are carpet grass, Bermuda grass, Johnson grass, and others. Bur clover and Lespedeza grow wild, especially in the open spaces. Around the heads of draws and on moist slopes there are alder thickets and an occasional cedar, and birches are to be seen on creek banks. Switch cane grows thickly on the fairly well-drained bottom lands.

Forest fires are set by many cattlemen and farmers, during the dry periods in winter and spring, to clear out underbrush and slashings and in the belief that such fires are beneficial in getting rid of cattle ticks and boll weevils. During this survey, many woodland areas were seen where serious destruction of young timber, especially pines, had resulted from fires. The tendency is toward the reforestation of such areas to hardwoods, mainly inferior oaks, rather than to the more desirable pine. Injury to trees, grasses, and native clovers by fires has been demonstrated. Steps toward the prevention of annual wood fires are now being undertaken by timberland owners, cattle-

men, and farmers. In addition, an educational campaign is now in progress in the timberland areas of Texas, emphasizing forest conservation and reforestation methods.

Lumbering has been an important industry in Nacogdoches County for the last 25 years. Although there were sawmills here as early as 1834, the best timberlands of east Texas were practically valueless as late as 1870, owing to the comparative inaccessibility of the larger timber markets. About 1900, lumbering was begun in the county on a considerable scale. Most of the standing timber was shortleaf pine. Hardwoods have been overlooked until recently, owing to the fact that ample supplies were obtainable elsewhere. The hardwoods now being cut are largely oaks and gums. About 75 per cent of the merchantable timber of the county, some of which is second growth, has now been cut. The largest sawmill in the county is at Nacogdoches.

SOILS

Nacogdoches County lies in the coastal plain, a region underlain by sandy, clayey, and calcareous deposits which are mainly unconsolidated. The alternation of broad bands of clays and sands with other bands of more compact sandstones and clays, which extend westward from Sabine River, are reflected in the surface relief by belts of comparatively level country bounded on the south by lines of hills more or less abrupt on their northern faces and dipping southward with gentle slopes to the plains. These belts are, in turn, dissected by streams into a hilly or gently rolling country.

The soils on the uplands of the county have been derived directly from these sediments. Their present characteristics are traceable in part to the nature of the underlying parent materials and in part to the forces of weathering. The alluvial, or stream-terrace and bottom soils, owe their derivation to material removed from the uplands by erosion and subsequently deposited in the alluvial plains of the rivers. Practically all the materials composing the alluvial soils of the county have been derived, directly or indirectly, from coastal-plain sediments.

The soils of the county have been developed under warm, humid climatic conditions, and when maturely weathered they are prevailingly low in organic matter, in lime, and generally in available plant food. Changes effected by weathering of parent materials agree, generally, as to character, but vary as to extent in the different soil groups, depending largely on the length of time during which weathering agencies have been operating on them. Consequently, there are soils in the county which are in a maturely weathered condition, others which represent gradational stages, and still others in which weathering has been only slightly effective.

Changes in the soil materials through weathering are principally the effects of oxidation, of solution by percolating and running water, and of the growth and decay of vegetation. Oxidation, which is governed largely by the drainage condition of the soil concerned and the porosity of its constituent materials, has been the principal chemical reaction and has resulted in the development of the conspicuous soil tints of red, yellow, and brown. In most of the well-weathered soils, the removal of the clayey particles from the upper or

eluviated horizon and their concentration at a lower level have been associated with the similar migration of such soil substances as lime carbonate and sulphate, iron oxides and silicates, aluminum silicates, colloids, and other compounds. The more soluble lime compounds have been entirely leached out of the well-weathered soils of the county. Accumulations of organic residues account for the dark-brown and dark-gray surface layers. The development of light-gray and mottled colors in soils having either poor internal or surface drainage is caused by the prevention of normal oxidation, through the exclusion of air.

The soils of this county have been developed under relatively high mean annual temperatures, moderately high humidity, and a mean annual precipitation sufficiently large to place the county well within the humid climatic belt.

Under these climatic conditions, the soluble lime and other alkaline earth salts of the well-weathered soils have been dissolved and carried away in the drainage waters. There are no appreciable areas of soils in the county which are calcareous in their surface horizons; but lime carbonate, in sufficient quantities to be detected by treatment with dilute hydrochloric acid, was found in the parent material underlying the soils of the Wilson, Sumter, and Nacogdoches series. The content of organic matter of nearly all the well-weathered soils is low, owing to small natural accumulations with rather rapid dissipation by oxidation under the prevailing climatic conditions. Exceptions to this condition are the fairly well-weathered Wilson clay loam and, to a less extent, Sumter clay. These soils have a fairly deep, black surface organic layer from which the soluble lime salts have been leached, but an abundance of lime is found in the subsoils of both soils at a depth ranging from 3 to 5 feet. The rather low natural fertility of most of the well-weathered soils of the county is due in part to lack of ample organic matter and lime, in part to the dominantly sandy texture of the surface soils, and in part to the mineralogical constitution of the soil materials.

The ability of the weathering agencies to penetrate and act on the parent soil materials has determined, to a large degree, the nature of the resultant soils and their profile characteristics. It might be noted that penetrability of the materials by water and air is the condition necessary for the development of soils as satisfactory media for the growth of most plants. Impenetrability is brought about in this county by impervious clay strata or the presence of excessive amounts of soil water, causing a water-logged condition.

The parent soil materials may be grouped into very friable sandy clays high in content of sand, medium sandy clays, and tough sandy clays high in clay.

The deep sands, such as those of the Norfolk and Ruston series, readily absorb all but the heaviest downpours and retain considerable moisture in the pores of the soil. The excess moisture entering the soil seeps downward through the sandy subsoil and substratum to the dense lower beds. These percolating waters from the sand-hill soils are the source of numerous springs on the slopes and stream heads in the sand-hill regions and supply them with water during periods of drought. The upland clays of the Kirvin series represent the opposite extreme, as far as texture and permeability are

concerned. The effects of weathering are slight in these soils, the original parent material being close to the surface.

The maturely weathered soils of the sand-hill group, namely the Norfolk and Ruston fine sands, exhibit a slight surface accumulation of dark-colored organic débris mixed with fine sand, immediately underlain by a layer, which extends to a depth ranging from 3 to 50 feet, of homogeneous grayish-yellow or yellow fine sand, in the Norfolk soil, and grayish-yellow or yellowish-red in the Ruston. The reddish fine sands in Ruston fine sand are everywhere within the reach of a 3-foot soil auger. These sand layers comprise the well-leached or eluviated horizon, designated as A. The horizon of concentration, designated as B, is rather friable sandy clay, high in content of sand, mottled, blotched, or streaked with alternating reddish and yellowish colors predominating in the Norfolk soil, but the reddish color predominating and being less mottled or more solid in the Ruston. The B horizon may be found just below the 3-foot depth or it may lie much deeper, as in the large sand-hill areas. The C horizon, or parent material, has not been definitely identified. It is possible that wind action may have been effective in the deposition of these deep sand soils.

The maturely weathered soils derived from the medium sandy clays are grouped in the Norfolk, Ruston, and Orangeburg series. These soils, in the virgin condition, all have a surface organic layer from 1 to 3 inches thick. The mineral topsoils of all three series are yellowish-gray fine sand. The B horizon, or zone of concentration, is friable sandy clay, yellow in the Norfolk, yellowish red in the Ruston, and red in the Orangeburg soils. The soils of the Greenville series also have a red sandy clay B horizon and belong in this group, but they differ from soils of the other three series in that the red color extends to the surface. The C horizon of these four series consists of slightly more friable medium sandy clay, which in most places is the same color as the B horizon of the separate series.

The Nacogdoches soils are "red-land" soils derived from a clay formation characterized by a high content of glauconite and a considerable percentage of lime carbonate in the form of sea shells. This clay is brittle or easily fractured, is porous, and is neither sticky nor plastic. In the surface soil in uncultivated areas a small amount of dark organic matter has been incorporated. Unless erosion has been active, the soils of this series have a well-developed, strongly reddish A horizon. The B horizon consists of brittle red clay containing some seams of yellow or ocherous-yellow clay, which are remnants of the partly weathered parent materials below. The upper part of the C horizon is yellow, somewhat stratified clay with seams of ironstone, ferruginous argillite, and shell casts. The lower part, in most places below a depth of 6 or more feet, is calcareous greensand or greenish clay containing glauconite, shell, high percentages of iron, and in places thin beds of limestone or of lignitic material. The presence of pebbly iron concretionary material, scattered on and through the soil, is a prominent feature of the soils of the Nacogdoches series.

The Bowie soils are derived from sandy clays, high in clay, of rather tight, semiplastic consistence. In the surface soil there is a noticeable accumulation of organic matter in the uncultivated

areas, with the usual leached sandy layer beneath making up the remainder of the A horizon. The B horizon consists of rather compact sandy clay, commonly yellow but in places reddish in color, the lower part of which, at a depth of about 2 or 2½ feet, becomes conspicuously mottled with red and yellow. Gray mottles are present at greater depths, where the texture approaches clay. The underlying parent material, or C horizon, consists of yellow and gray mottled heavy sandy clay which is plastic in some places.

In the Kirvin soils the surface organic layer is more noticeable than in the other upland soils, and the underlying, in most places comparatively thin, pale yellowish-gray fine sand or well-leached layer makes up the remainder of the A horizon. The B horizon, or zone of concentration, is not at all well developed and in places is nearly absent. It is red, stiff, brittle or plastic clay. Immediately below it is the characteristic red and yellow, mottled, plastic heavy clay, which is the slightly weathered parent material from which the soils of this series have been derived. This becomes, in most places, higher in percentage of gray or light-gray coloration with increasing depth. It has a thinly laminated structure.

The remaining series identified and mapped in the county also show varying degrees of profile maturity. The soils of the Wilson series occur where calcareous parent material comes rather close to the surface. Their conspicuous features are a highly organic, nearly black A horizon, underlain by a B horizon of moderately tough yellow clay which becomes calcareous at a depth of 4 or 5 feet below the surface, where the parent material, or C horizon, of yellowish or greenish shell-bearing clay is found. The Sumter soils are likewise immaturely weathered. They are derived from calcareous materials, are very dark, and the unchanged parent material of dense, plastic, very heavy, yellowish calcareous clay occurs at a slight depth. The soils of the Lufkin series, the only very poorly drained upland soils, show no profile development resulting from weathering. They have dark-gray surface soils and light-gray, mottled subsoils.

The terrace soils of the Kalmia, Cahaba, Leaf, and Myatt series correspond closely in color, texture, and horizon arrangement to the related upland soils of the Norfolk, Ruston, Kirvin, and Lufkin series, respectively, except that, as they are comparatively younger, the separate horizons are not so sharply marked. In the gray, mottled soils of the Myatt series occurring on the stream terraces there is no discernible weathered profile.

The bottom-land soils of the Ochlockonee, Hannahatchee, and Bibb series are being built up by sedimentation during periods of overflow. Although the soil particles of which they consist were well weathered in the upland positions from which they have been washed, they have not been in place sufficiently long to have been noticeably weathered. The Ochlockonee soils are brown, are in many places texturally stratified, and are fairly well drained. The Hannahatchee soils are similar but are red in color. The Bibb soils occupy the flat, low, stream-bottom positions and are very poorly drained, mottled, crawfish soils, largely of clayey texture.

A large proportion of the upland and terrace soils of the county are deep well-drained sandy soils, which are easy to cultivate. Their

openness allows thorough aeration, with corresponding susceptibility to severe leaching and rapid depletion of organic matter, particularly under clean cultivation. When properly supplied with organic matter, fertilized, and well cultivated, these deep sandy lands are, to some extent, profitably used for the production of a variety of crops, such as cotton, corn, oats, forage crops, peanuts, vegetables, melons, peaches, plums, and small fruits. In large areas of sandy upland and terrace soils a sandy clay subsoil lies at a depth ranging from 1 to 2½ feet. Such soils are good or fair agricultural soils, for the most part, are easy to cultivate under a wide range of moisture conditions, do not leach out so rapidly, and are therefore stronger soils than the deep sands. There are also considerable areas of fine-textured soils that require heavier implements and equipment for adequate cultivation. Their fertility is not so rapidly depleted, as they are not so readily leached of their soluble constitutents. Some of the best agricultural soils of the county are included in this group.

The principal areas of the deep sands may be located on the accompanying soil map as the Norfolk and Ruston fine sands. Soils of the second textural group mentioned may be found by locating the numerous widely distributed areas of the Norfolk, Ruston, Orangeburg, Cahaba, and Kalmia fine sandy loams, and their deep phases, and Greenville fine sandy loam. The Greenville soil is popularly known as one of the sandy red-land soils. A subgroup is represented by the fine sandy loam of the Nacogdoches series which has a clay subsoil. This is the common sandy red-land soil and is important agriculturally. Kirvin fine sandy loam also belongs in this subgroup.

The finer-textured agricultural soils of the uplands belong largely to the Nacogdoches series and are mapped as Nacogdoches clay loam. The few scattered small areas of the dark-colored Wilson clay loam also belong in this group. The less-productive and less-developed Sumter clay is likewise a fine-textured upland soil.

The sandy-textured bottom lands occur principally in the upper parts of the stream bottoms and near the channels of the larger streams. The finer-textured or clayey recent-alluvial soils are found on the broad, level bottoms, the poorly drained soils of the Bibb series occupying the lowest positions.

Since the advent of the white settlers, indiscriminate lumbering methods and careless farming practices have stimulated destructive erosion, which is most noticeable on the steeper slopes of the uplands but also affects the gentler-sloping fields and areas. During the occasional torrential downpours, the run-off commences, on all slopes, in the form of sheet wash, which soon collects into rivulets of rapidly moving water carrying along loose soil particles. Gullies are soon formed by removal of soil and the erosive action of swiftly running water loaded with sediment. Severe gullying of fields, washouts along roads, and the removal of large quantities of top-soil, together with whatever fertilizers and plant residues may have been present, are common in various parts of the county. The damage from soil erosion is not only severe on the uplands, it also results in covering fertile bottom lands with layers of sand. It is

true that some of the important soils of the county are particularly susceptible to erosion, on account of their loose, friable, single-gain, sandy surface soils and rolling relief and the practice of shallow plowing and of raising clean-cultivated crops.

It has been the practice of some farmers to run the rows of cultivated crops up and down hill. A more destructive method could scarcely have been devised. Deeper plowing allows greater absorption of rain water and is a good farm practice for other reasons, but it is not common. The most destructive form of erosion, from the viewpoint of agriculture, is probably sheet wash. When sheet wash is active, small quantities of surface soil are removed periodically and carried away so gradually that the loss is not noticed by the farmers.

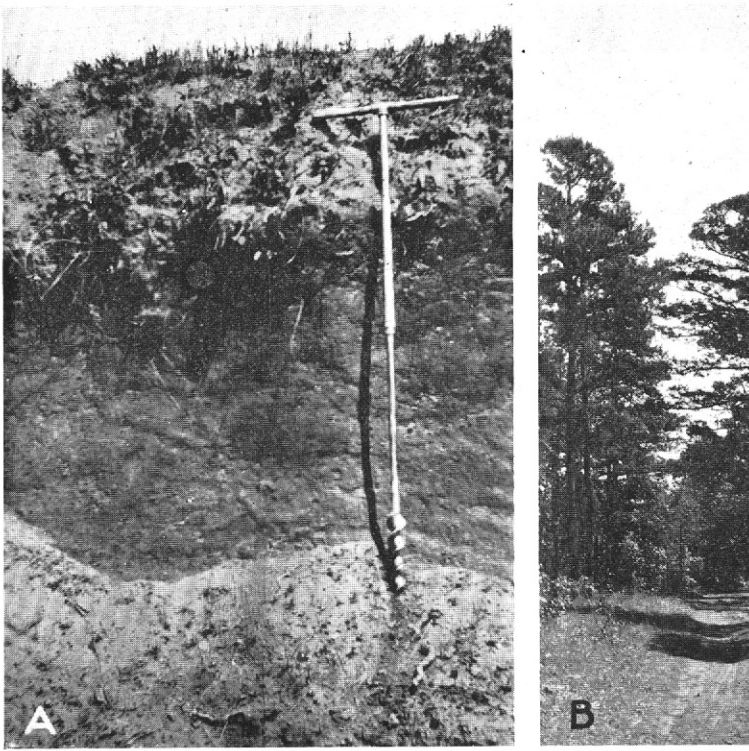
Two general types of gullying are common in the county. Deep porous sandy lands lacking dense subsoils absorb large quantities of water rapidly until they are saturated and do not, therefore, wash so quickly or so severely as the heavier soils. Deep gullies tend to form in sloping fields of such soils, and to deepen with age, eating their way uphill as the vertical walls of the gullies cave in during rainy periods. On sloping areas of soils having clay subsoils, the run-off commences much more quickly, as the clays do not have the ability to absorb large quantities of water rapidly. The resultant erosion forms what might be described as an intricately branched system of tiny streamlet courses, which become rapidly larger and deeper in the direction of the steepest slope.

As the principal upland agricultural soils of the county have clay subsoils and as the relief is generally rolling, erosion has in recent years played havoc in cultivated fields. An outstanding need of the county is the artificial terracing of all lands which tend to erode.

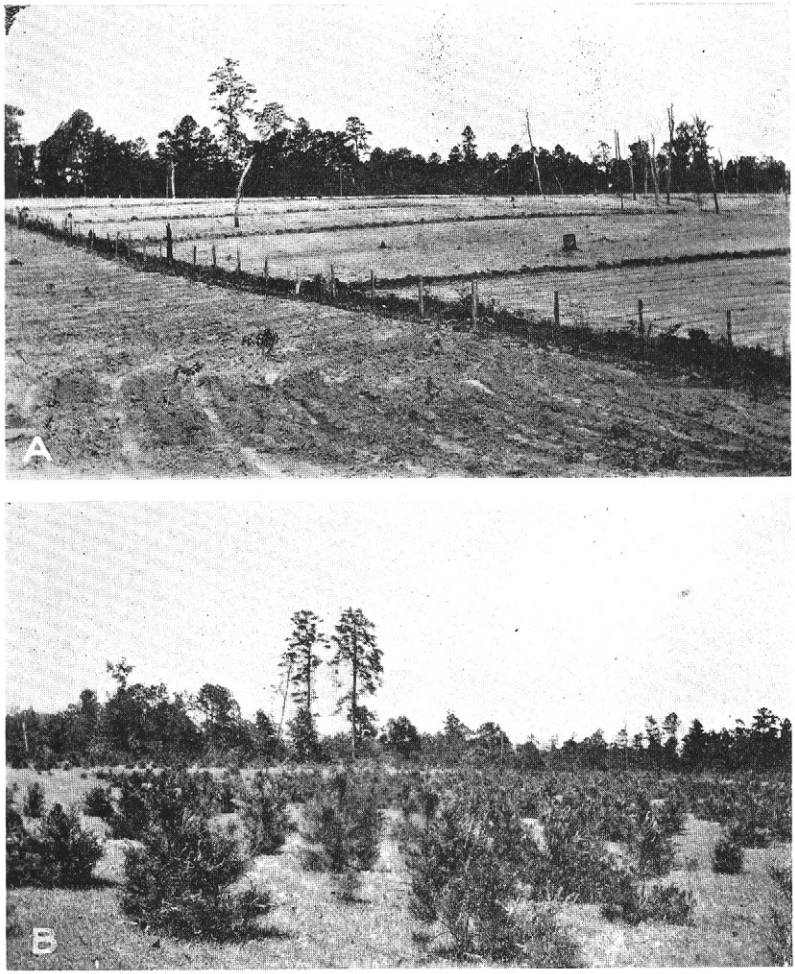
In the following pages of this report the soils are described in full and their agricultural importance is discussed; their distribution is shown on the accompanying soil map; and their acreage and proportionate extent are shown in Table 2.

TABLE 2.—*Acreage and proportionate extent of soils mapped in Nacogdoches County, Tex.*

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Norfolk fine sand	65,280	10.4	Wilson clay loam	1,472	0.2
Norfolk fine sandy loam	5,760	3.0	Sumter clay	704	.1
Deep phase	12,864		Kalmia fine sand	2,496	.4
Ruston fine sand	14,144	2.3	Kalmia fine sandy loam	3,136	
Ruston fine sandy loam	73,024	22.9	Deep phase	5,184	1.4
Deep phase	68,800		Rolling phase	832	
Gravelly phase	1,472		Cahaba fine sandy loam	7,232	
Orangeburg fine sandy loam	2,496	.6	Deep phase	1,856	1.5
Deep phase	1,216		Leaf fine sandy loam	3,392	.5
Greenville fine sandy loam	1,216	.2	Myatt very fine sandy loam	128	.1
Nacogdoches fine sandy loam	39,360	6.3	Ochlockonee fine sand	3,456	.6
Nacogdoches gravelly fine sandy loam	31,360	5.0	Ochlockonee fine sandy loam	33,472	5.3
Nacogdoches clay loam	10,176	1.6	Ochlockonee very fine sandy loam	23,296	3.7
Nacogdoches gravelly clay loam	19,968	3.2	Ochlockonee silty clay loam	15,296	2.4
Kirvin fine sandy loam	124,672	20.6	Hannahatchee fine sandy loam	3,904	.6
Deep phase	4,224		Bibb fine sandy loam	2,624	.4
Kirvin clay loam	14,848	2.4	Bibb clay loam	20,736	3.3
Bowie fine sandy loam	5,632	.9	Total	625,920	
Lufkin loam	192	.1			



A, Profile of Ruston fine sandy loam; B, growth of shortleaf pine on Ru



A Terraces on a fairly steep slope on Ruston fine sandy loam, deep phase; B, natural reseeding of shortleaf pines in a pasture on Ruston fine sandy loam, deep phase

NORFOLK FINE SAND

Norfolk fine sand, under forest conditions, consists of the following layers from the surface downward: (1) Dark-gray fine sand or loamy fine sand, an inch or less thick; (2) pale yellowish-gray incoherent fine sand from 12 to 15 inches thick; (3) pale-yellow or yellow incoherent fine sand, extending to a depth of 3 feet in the smaller isolated hilltops or similar areas but to a depth ranging from 30 to 50 feet in the large sand-hill regions; (4) mottled, blotched, or streaked yellow and red sandy clay, rather high in content of fine sand and rather hard but permeable. The deeper parent materials, as far as is known, are similar to the fourth layer.

This soil is rather uniform, but the surface soil in some areas approaches very fine sand in texture. No material coarser than fine sand was found in areas mapped as Norfolk fine sand. On cut-over land or in old pastures, the topsoil may be darker than usual, owing to the presence of more organic matter. In plowed fields, the soil is incoherent yellowish-gray, light-gray, or nearly white fine sand, which in some places resembles beach sand, depending on whether or not the farmer has maintained the original content of soil humus.

This soil gives a neutral or slightly acid reaction. It is one of the extensive soil types of the county. The largest areas extend from about 4 miles north of Appleby to the Rusk County line, lie within a radius of 6 or 7 miles of Nacogdoches, and occur 3 miles northwest of Martinsville. Many smaller areas are scattered throughout the county.

The characteristic relief of Norfolk fine sand varies from gently undulating or gently rolling to rolling. Nearly all the larger areas, which are dissected by streams, exhibit all the variations in relief mentioned. On the top of Floury Mountain there is a considerable area which is smooth or nearly flat. Near Union Cross School, 3 miles northwest of Nacogdoches, is a nearly flat area covering about 400 acres. Most of the soil is undulating or rolling. Only a small percentage has steep slopes, and only a small total area has been seriously gullied by erosion.

Drainage on this soil is good, except in a few small depressions. On the flatter areas and gentler lower slopes the soil is said to be cold and late. Undulating areas are also regarded as comparatively late in that they absorb more of the spring rains and retain them better and therefore do not warm up so rapidly as the less-permeable heavier upland soils which hold less moisture. A large part of the rain falling on this soil is quickly absorbed. The single-grain structure provides, to some extent, self-mulching ability, assisting in the prevention of undue evaporation from capillarity.

Most of this soil is regarded as being drought resistant. In wet seasons, the few wetter areas do not produce well on account of the excessive quantities of water retained. In dry seasons, all but the more rolling areas are resistant to drought, particularly for the deeper-rooted crops like watermelons. As the subsoil is not dense, the underdrainage from the root zone of most plants is excellent.

Norfolk fine sand is not an important agricultural soil in Nacogdoches County. Only about 15 per cent of it is in cultivation. Most of it supports native timber and a thin stand of native pasture

grasses, weeds, shrubs, and bushes. Pine, stunted post oak, blackjack oak, sand jack oak, small hickories, and a scattering of other trees constitute the tree growth. Beargrass and broom sedge are common in some localities. Old fields contain sumac, blackberries, sand or bull nettles, broom sedge, dog fennel, and other weeds and grasses. The deeper areas do not produce so fast-growing or so dense a stand of timber as the areas in which the sandy clay substratum is within 6 feet of the surface.

Crops grown are cotton, corn, cowpeas, velvetbeans, peanuts, watermelons, garden vegetables, some tree fruits, and berries. Dairying and hog raising are carried on to a small extent. Peanut growing, in connection with the fattening of hogs, is common. Cornfields are also grazed by cattle and hogs. Watermelons and peanuts are the most productive crops grown. Berries thrive, but their culture has not been attempted on a commercial scale, as it has in near-by Smith County on this soil.

Cotton usually yields from one-fourth to one-third bale to the acre. The maintenance of fertility by rotation and fertilization has not received much attention from the farmers in general. A few, by the use of barnyard manure or cottonseed meal or the plowing under of leguminous crops together with moderate amounts of complete fertilizer, have obtained from one-half to three-quarters bale of cotton to the acre and from 20 to 25 bushels of corn. The corn yield on this soil, in its usual condition, is rarely more than 10 bushels to the acre. It is not customary to fertilize corn. Peanuts yield from 20 to 30 bushels to the acre. Small amounts of barnyard manure or cottonseed meal are used under the hills of watermelons. Cowpeas are usually grown in alternating rows with corn. When picked for seed, the yields are from 10 to 15 bushels to the acre. When cut for hay, several tons to the acre are obtained.

This soil commands from $3 to $10 an acre, in second-growth timber. Improved land brings from $15 to $30 an acre, depending on improvements and location.

Large areas of this soil, unimproved as yet, are suitable for diversified farming, trucking, or fruit growing. Most of the land can be bought at prices sufficiently low to allow the expenditure of labor and fertilizer needed to put the soil into paying, productive condition. No practical permanent method of agriculture has been worked out on this soil which does not include specific means for maintaining or increasing the supply of organic matter and adding fertilizers to supply the deficiencies of plant food. The most practical method of supplying soil organic matter on the average farm is either by plowing under a crop of legumes or a winter cover crop such as oats and vetch. A winter cover crop provides winter pasture, protects the land from erosion by winter rains, and, what is especially important on this soil, utilizes fertilizers that may otherwise be leached out and lost. The addition of moderate amounts of complete fertilizers is necessary if good yields are expected. From 200 to 400 pounds to the acre of 4–10–4, 4–8–4, or 3–10–2 fertilizer are used, depending somewhat on soil conditions and crops to be grown.

Diversified farming, embracing the growing of summer and winter legumes and winter grains, with peanuts, watermelons, cotton, and small fruits as cash crops, is recommended.

NORFOLK FINE SANDY LOAM

Norfolk fine sandy loam, under forest conditions, consists of: (1) Dark-gray fine sand or loamy fine sand an inch or less thick; (2) pale yellowish-gray incoherent fine sand, which becomes grayish-yellow or pale-yellow fine sand or loamy fine sand near the sandy clay subsoil; (3) below an average depth of 12 or 15 inches, yellow friable sandy clay several feet thick. The deeper parent material, as far as it was observed, was predominantly yellow sandy clay, slightly more friable than the subsoil. Oxidation has penetrated to a considerable depth in these deposits, causing the solid yellow color.

This soil is fairly uniform. The surface texture does not vary noticeably from place to place, except that small depressed areas or lower slopes tend to become darker and more loamy. In places the subsoil tends to be more compact than typical. In cultivated fields, the soil is rather incoherent fine sand, yellowish gray or light gray in color depending on the content of organic matter. The soil is uniformly acid in reaction. The maximum acidity is in the sandy clay subsoil.

This is not one of the most extensive soils of Nacogdoches County. The largest areas are 2 miles west of Lilbert and at Alazan. The characteristic relief of Norfolk fine sandy loam is gently undulating or gently rolling. A much larger percentage of this soil is comparatively smooth or gently sloping than of the related Ruston and Orangeburg fine sandy loams. Drainage is, as a rule, good. The internal water movement is unhampered by impervious strata, and the internal drainage conditions are favorable. On a few flatter areas, in wet seasons, the soil tends to be cold or late for early spring planting on account of local sluggish drainage. A large part of the rain falling on this soil is, as a rule, absorbed. The friable sandy clay subsoil acts as a reservoir for the storage of subsoil moisture.

This is a reasonably drought-resistant soil. In dry seasons all but the rolling areas sustain the ordinary crops well if the surface soils have been protected from erosion by terracing and contain a reasonably good supply of organic matter.

This soil, though not very extensive in the county, is one of the important agricultural soils. About 35 per cent of the total area mapped is in cultivation. The remainder is in forest, mainly of pine; post, blackjack, red, and white oaks; hickory; gums; and other upland trees. This is a productive timber soil but is also one of the better agricultural soils.

Crops grown are cotton, corn, cowpeas, velvetbeans, peanuts, sweetpotatoes, sorgo, oats, tree and small fruits, and garden vegetables. Cotton yields from one-quarter to three-quarters bale to the acre and corn from 12 to 25 bushels. Sweetpotatoes yield from 100 to 200 bushels to the acre. This is considered a good soil for pecans, grapes, pears, and peaches. It is said that it does not produce such highly colored peaches as do some of the red upland soils which contain a higher percentage of iron.

Dairying and hog raising prevail on this soil. Pastures are much better than on the deep sand soils. Bermuda is the principal grass, and some bur clover and Lespedeza are seen. The soil supports fairly good tame pastures, when the land is properly prepared and

seeded. This is a good general-farming soil and is adapted to nearly all the crops commonly grown.

Land values range from $15 to $40 an acre, depending on improvements and location.

In cultivating this soil it has been the custom, after the first clearing, to plant cotton for several successive years or in a 2-year rotation with corn and cowpeas. Comparatively small areas are devoted to other crops. From 150 to 300 pounds to the acre of commercial fertilizer of approximately 3–10–2 formula is customarily applied to cotton. Some farmers use low-grade fertilizers and some use only superphosphate. The growing of clean-cultivated crops, without adequate provision for supplying fresh organic matter to replace that removed or burned out, has brought about a reduction of the organic-matter supply.

This soil can economically be made more productive and capable of supporting a better and more diversified agriculture. Terracing is important for soil conservation, as are improvement in cropping systems and methods of increasing soil fertility. In connection with the description of Ruston fine sandy loam, a closely related and much more extensive soil in this county, are recommendations applicable also to this soil.

Norfolk fine sandy loam, deep phase.—Norfolk fine sandy loam, deep phase, under forest conditions, consists of: (1) Dark-gray fine sand or loamy fine sand an inch or less thick; (2) pale yellowish-gray incoherent fine sand which grades into grayish-yellow or pale-yellow fine sand or loamy fine sand near the sandy clay deeper subsoil; (3) below an average depth of 30 inches, yellow, friable sandy clay several feet thick. The soil is moderately acid in reaction, especially in the deeper sandy clay subsoil.

This soil very closely resembles Norfolk fine sandy loam, to which it is related. It differs in that the sandy soil layers overlying the sandy clay subsoil are from 15 to 30 inches thick, instead of from 12 to 15 inches. Also, in places the subsoil tends to become more compact than is typical and in a few places is slightly mottled with red. A larger percentage of the areas of this phase of soil are more nearly flat or gently undulating than is true of Norfolk fine sandy loam, and a few of the flatter areas are moundy or billowy. The mounds are made up of deeper sandy material, from 3 to 5 feet thick.

This is not a very extensive soil in this county. The largest areas are 4 miles east of Melrose, near Alazan, 2 miles northeast of Woden, and south of Fern Lake.

The characteristic relief is gently undulating. Probably a larger percentage of this soil has a comparatively smooth or level surface than any other upland soil. Drainage is good in most areas. Absorption of rain water is fairly rapid, and, as the overlying sandy layers are thicker than in Norfolk fine sandy loam, a higher percentage can be quickly taken up. The subsoil is reasonably porous and retentive of moisture. This is a drought-resistant soil.

This soil, though not one of the most extensive, is important agriculturally. About 25 per cent of it is in cultivation. The forested areas support a good growth of the same type of forest as does Norfolk fine sandy loam.

The principal crops grown are cotton and corn. The usual miscellaneous secondary crops, such as sweetpotatoes, peanuts, watermelons, sorghum, oats, cowpeas, velvetbeans, tree and small fruits, and vegetables, are also grown. The yields compare favorably with those obtained on typical Norfolk fine sandy loam, though yields of peanuts and other deep-rooted crops are somewhat better. Watermelons do well. This is a very good soil for raising pecans, grapes, orchard fruits, and berries. It is not quite so desirable for the shallower-rooted crops, such as grasses, but on the whole it is a good general-farming soil, suited to most crops commonly grown in the county.

Methods of handling this soil do not vary noticeably from those used in the cultivation of Norfolk fine sandy loam and recommendations for improvement are the same.

RUSTON FINE SAND

Ruston fine sand, under forest conditions, consists of the following layers: (1) Dark-gray fine sand or loamy fine sand an inch or less thick; (2) pale-yellowish or pale yellowish-red incoherent fine sand, which in most places becomes more intensely yellowish red or rust red at a depth of 12 or 15 inches; (3) rather incoherent yellowish-red or rust-red fine sand extending to a depth of 3 feet in the smaller areas and to 10 or 15 feet in the larger sand-hill regions; (4) rather hard but permeable sandy clay, rather high in content of fine sand, commonly solid yellowish red in color and in most places not conspicuously mottled or streaked. The deeper parent materials, so far as is known, are similar in character and color.

This soil is less uniform than its companion sand-hill soil, Norfolk fine sand. On the crests of slopes and the more abrupt knolls and spurs there are included in mapping small areas of Ruston fine sandy loam and its deep phase. Small areas of Ruston fine sand occur in the Norfolk fine sand belts, where the underlying parent materials come within 3 feet of the surface and are well oxidized to the reddish-yellow color.

The presence of scattered reddish finer soil particles through the upper sandy layers gives to this soil its characteristic color. The sand grains themselves have the usual grayish cast of impure quartz. In a very few places, there is a surface scattering of small brown iron concretions. In plowed fields, the soil is pale reddish-gray or yellowish-red fine sand, though there are areas where the reddish-yellow tint does not show at all in the surface soil.

This soil is neutral or very slightly acid in reaction. It is not very extensive in the county. More than half the total area in the county is in one large body north of Appleby. Small areas are around Nacogdoches and northeast of Trawick.

Areas of this soil, as of Norfolk fine sand, are undulating, gently rolling, or rolling. The soil occupies more of the steeper slopes than is characteristic of the more extensive Norfolk fine sand. There is a nearly flat area near Brileytown Church.

Drainage of this soil is good or excessive. Undulating areas are, however, regarded as late, as are similar areas of Norfolk fine sand. In other moisture relationships, these two soils are similar. A little

more fine material distributed through the sandy mass, together with dense substrata that as a rule in the larger areas occur comparatively nearer the surface, allows for a somewhat higher moisture retentiveness and fertility in Ruston fine sand than in Norfolk fine sand. The undulating areas are regarded as drought resistant, but in dry seasons the more rolling areas, on account of their excessive drainage, dry out.

Ruston fine sand is not an important soil. About 15 per cent of it is in cultivation. Most of it supports a stand of pine; blackjack, post, white, and sand jack oaks; small hickories; black walnut; and some gums. The few areas cultivated produce from one-quarter to one-half bale of cotton to the acre, from 10 to 15 bushels of corn, and fairly good yields of cowpeas, sweetpotatoes, and vegetables. Watermelons, peanuts, and berries are well adapted to this soil. The methods of cultivation, fertilization, and handling are the same as for Norfolk fine sand.

This soil commands from $3 to $30 an acre, depending on improvements and location.

Improved methods of farming are needed on many of the cultivated fields of this soil. As has been amply demonstrated elsewhere, the less-rolling or smoother areas can be economically maintained in a good state of productivity by incorporating organic matter in the soil, by following suitable crop rotations, and by practicing better cultivation and fertilization than are in common use at present. Methods recommended for the improvement of Norfolk fine sand apply also to this soil.

RUSTON FINE SANDY LOAM

Ruston fine sandy loam, under forest conditions, consists of: (1) Dark-gray fine sand or loamy fine sand an inch or less thick; (2) pale yellowish-gray, grayish-yellow, or pale reddish-yellow fine sand or loamy fine sand; (3) below an average depth of 12 or 15 inches, reddish-yellow or yellowish-red friable sandy clay many feet thick, which where typical blends with the slightly less dense or more friable yellowish-red sandy clay parent materials. (Pl. 1, A.) Small brown pebbly iron concretions are scattered over the surface of the knobs and smaller hilltops.

This soil is variable, especially in the color of the subsoil, in texture, and in relief. Commonest inclusions, as mapped, are small areas or knobs of Nacogdoches fine sandy loam and Nacogdoches gravelly fine sandy loam. Small strips of Norfolk fine sandy loam and its deep phase, located about stream heads, are also included. In parts of the county situated close to large areas of the Kirvin and Bowie soils there are inclusions of small areas of these soils. The line of separation between these soils is in many places indistinct, and areas of Ruston fine sandy loam, along the lines of contact, may merge gradually rather than break off sharply, as the soil boundaries on the map indicate.

In cultivated fields, this soil is fine sand or loamy fine sand, generally yellowish gray on the smoother areas. On undulating or rolling fields the reddish-yellow color is conspicuous to the surface. The soil is uniformly acid in reaction, the maximum acidity occurring in the sandy clay subsoil.

This is an extensive and important soil and is of widespread occurrence throughout the county. It is found in numerous large connected areas, in association with other soils. The relief varies markedly. Large areas on the larger hilltops, broader ridges, and divides are gently undulating. These are mostly in cultivation. Most of the soil mapped, however, is gently rolling or rolling. Other large areas, mainly wooded, have fairly steep slopes in the hillier parts of the county. As a rule, this soil has a rougher surface than Norfolk fine sandy loam.

Regional drainage is good, as streams have dissected all areas. Internal drainage is good, except in a few nontypical areas which have a more tenacious or impervious subsoil, higher in clay than normal.

Prevention of erosion is a serious problem on most areas of this soil. Although the profile indicates suitable arrangement of the open, upper sandy layers and of the friable sandy clay subsoil beneath, the surface is in many places sufficiently sloping to make the percentage of run-off considerable during all but the gentler, soaking rains. On many sloping fields, particularly on upper slopes and crests, the subsoils are exposed in places, and in other places there is a comparatively thin covering of the remnants of the upper sandy soil. Absorption of rainfall by this soil is good on the flatter and also on the more sloping areas, where provision has been made for holding the run-off waters by terracing. Under such conditions, this is a drought-resistant soil. Under other conditions, it tends to dry out badly during summer droughts.

This is one of the most important of the gray sandy-land soils in the county. About 40 per cent of it is in cultivation. The forested areas support a good stand of pine (pl. 1, B) and mixed hardwoods common on the well-drained upland soils of the timber belt. Crops grown on Ruston fine sandy loam include nearly every farm crop produced in the county. Cotton, the main crop, produces from one-quarter to three-quarters bale to the acre. Enough corn is grown, as a rule, to feed the livestock. Corn yields from 10 to 25 bushels to the acre. Cowpeas and velvetbeans, which are commonly interplanted with the corn and pastured off, do well. Sweetpotatoes yield from 100 to 150 bushels to the acre and potatoes from 75 to 125 bushels. Oats produce fairly well, yielding from one-half to 1 ton to the acre of grain hay, in addition to furnishing winter pasture for livestock. Fruit trees are fairly productive, and a good quality of fruit is produced. A part of the early tomato crop is grown on this soil. Some peanuts are grown, as well as the miscellaneous garden vegetables. Dairying and hog raising are carried on to some extent.

Land values range from $15 to $40 an acre, depending on improvements and location.

As is true of other cultivated soils in the county, there is a wide variation in the productiveness of Ruston fine sandy loam on different farms. Some fields have suffered from gullying by erosion; in others, of more gentle slope, erosion in the form of sheet wash is periodically active in removing scarcely discernible quantities of the surface soil. A few farmers are producing excellent crops and obtaining normal and satisfactory farm profits from cotton, corn, various legumes, fruits, and early vegetables and livestock. Such

diversification is as yet uncommon, however, as most of the farmers are interested primarily in the production of cotton at the expense of other farm crops. Methods of replenishing the needed soil constituents in worn-out fields are receiving much attention. Terracing is being done more thoroughly than ever before. Three-year crop rotations are beginning to replace the growing of cotton year after year or of cotton followed by corn. A satisfactory and recommended rotation for this and similar soils is as follows: First year, cotton, followed by winter clover, which is pastured and plowed under in early spring; second year, corn, with cowpeas interplanted in it in May, both crops to be harvested and the residue plowed under or pastured and followed by fall-seeded oats and vetch; third year, oats and vetch to be cut for hay in the spring and followed by cowpeas or velvetbeans, planted in May. The legume crop is harvested for hay and the vines plowed under, then followed by fall-planted rye and vetch or a winter cover crop of clover to be plowed under in early spring in time to plant the land to cotton.

This rotation will greatly increase the quantity of organic matter in the soil, will stimulate productivity, and will provide ample nitrogen for strong vegetative growth. Larger amounts of fertilizers rich in phosphoric acid may then in most seasons profitably be applied to the cotton crop. Deeper plowing is needed to increase the absorptive power of the soil, so that the moisture-retentive properties of the organic matter gained may be better utilized.

This soil is suited to diversified agriculture, including livestock raising, but in order to obtain consistently good crop yields and maintain fertility, it is necessary to prevent erosion by terracing and to increase productivity by crop rotation, manuring with cover crops or otherwise, and fertilizing.

Ruston fine sandy loam, deep phase.—The deep phase of Ruston fine sandy loam, under forest conditions, consists of: (1) Dark-gray fine sand or loamy fine sand an inch or less thick; (2) pale yellowish-gray or yellowish-red incoherent fine sand, which becomes more intensely yellowish red and approaches fine sandy loam in texture close to the sandy clay subsoil; (3) below an average depth of 30 inches, friable sandy clay, typically yellowish red in color and several feet in thickness. The deeper parent material is the same as in Ruston fine sandy loam. The soil is moderately acid, the highest acidity being found in the sandy clay subsoil.

This phase of soil closely resembles Ruston fine sandy loam but differs in that the upper sand layers are from 15 to 30 inches thick instead of from 12 to 15 inches. The surface relief differs from that of typical Ruston fine sandy loam in that it is less rolling or hilly. A large proportion of the areas of this soil are more nearly flat or gently undulating, and many are marked by surface mounds, similar to those occurring on Norfolk fine sandy loam, deep phase. These mounds are from 3 to 5 feet high and are ovoid in shape, their diameters being from 10 to 20 or more feet. They are apparently remnants of sand mounds blown up about clumps of grass or other vegetation, possibly when marshy conditions prevailed over these flattish areas. There are some variations in subsoil textures and colors, similar to those mentioned in connection with Ruston fine sandy loam. The commonest inclusions are small areas of Ruston

fine sandy loam, its gravelly phase, and Nacogdoches gravelly fine sandy loam. In some of the flatter areas, there are small included strips of Norfolk fine sandy loam, deep phase.

In cultivated fields, the surface soil is grayish fine sand. The intensity of the darker tint varies with the length of time since the land has been put in cultivation or the quantity of organic matter present. In comparatively few places is the yellowish-red subsoil discernible on the surface.

This is both a very extensive and very important soil type in the county. The largest areas are like those of Ruston fine sandy loam in location and distribution. The relief is variable. Large areas on the broader divides and in parts of the county where stream erosion has not been so active are fairly smooth or gently undulating. Most of the soil has a gently undulating, undulating, or gently rolling surface. It is typically less rolling than Ruston fine sandy loam. A large proportion of the smoother areas is in cultivation. Large rolling areas are in timber. Drainage is good.

Prevention of erosion on cultivated areas of this soil is important on many farms. The sloping fields suffer periodical loss of surface soil by sheet wash and, to a less extent, by the deeper gullying during heavy rains. Absorption of rain water is good, however, especially on flatter areas and on sloping fields that have been terraced. (Pl. 2, A.) This is normally a drought-resistant soil, particularly where a reasonable supply of organic matter is retained in the surface soil, erosion is prevented, and cultivation is thorough.

This is one of the most important gray sandy-land soils of the county. About 40 per cent of it is in cultivation. The forested areas support excellent stands of pine; white, red, post, and blackjack oaks; upland hickories, gums, some ash, persimmon, hackberry, walnut, and other trees. Pine is preferred for lumber, and this soil will reseed itself mostly to pine (pl. 2, B) if some care has been taken, during the first cutting, to leave mother trees capable of growing and scattering crops of seed. If fires are common or pine seedlings are lacking, the hardwoods will make a thick growth in a few years.

Ruston fine sandy loam, deep phase, is devoted mainly to cotton and corn. Cotton produces from one-fourth to three-fourths bale to the acre and corn from 10 to 25 bushels. Cowpeas and velvet-beans produce well. Sweetpotatoes yield from 75 to 150 bushels to the acre and potatoes from 75 to 125 bushels. Oats provide some winter pasture and are cut for grain hay in the spring. Tree fruits, pecans, grapes, and berries thrive, and peanuts, watermelons, and the usual garden vegetables do well. Shallow-rooted crops do fairly well, except on the more rolling areas where moisture conditions are apt to be unfavorable during periods of drought. This soil is particularly suited to trees and crops which have a well-developed root system. Dairying and hog raising are carried on to some extent.

This soil is handled and fertilized very much as is Ruston fine sandy loam. It commands from $10 to $35 an acre, depending on location and improvements.

This soil is subject to the same variations in condition and productivity as is the typical soil, and recommendations as to terracing,

increasing the amount of organic matter, and rotating crops are the same for the two soils.

This soil is suited to diversified agriculture, including dairying and the raising of livestock and poultry. However, if consistently good crops and sufficient supplies of feed crops are to be produced, it is necessary to follow better farming practices than are the rule in the county at the present time.

Ruston fine sandy loam, gravelly phase.—The gravelly phase of Ruston fine sandy loam differs from typical Ruston fine sandy loam in that the soil mass to a depth of several feet carries a fair or large percentage of dark-brown or rust-brown small iron concretions, ferruginous gravel, and fragmentary ironstone and iron sandstone. Without sharp delineation of profile change, the material grades, at a depth ranging from 8 to 12 inches, from reddish-yellow or dull-reddish gravelly fine sandy loam, with a slight surface accumulation of organic matter, to reddish or reddish-yellow, open, friable gravelly sandy clay.

This soil everywhere occupies elevated knobs, spurs, or smaller hilltops or ridges and occurs only in small areas. It is almost entirely timbered.

ORANGEBURG FINE SANDY LOAM

Orangeburg fine sandy loam, under forested conditions, consists of: (1) Dark-gray fine sand, loamy fine sand, or fine sandy loam an inch or less thick; (2) yellowish-gray or grayish-yellow fine sand or loamy fine sand, which in many places is reddish in the lower half and approaches fine sandy loam in texture near the sandy clay subsoil; (3) below an average depth of 12 or 15 inches, red, friable sandy clay, typically many feet thick, in which there is no marked textural or color change. The partly weathered parent material, as far as it was observed in deep road cuts, is somewhat more friable and less compact massive red sandy clay. Oxidation has penetrated to a depth of at least 15 feet below the surface, as the rather bright-red color of the materials signifies. At what depth the unweathered parent material lies was not determined.

In places, small iron concretions were scattered over the soil, and in a very few places small remnants of ocherous-yellow sandy clay were found in the deeper part of the subsoil, within 3 feet of the surface.

This soil occurs mainly in association with the Ruston and Nacogdoches fine sandy loams, and the line of separation between the soils is not everywhere sharply marked. Though the soil is very similar in composition, relief, and utilization to Ruston fine sandy loam, the color of the subsoil differs and in few places is it so tough and tenacious. This soil differs from Greenville fine sandy loam in that the surface soil is gray rather than red. In cultivated fields, the soil is grayish or yellowish-gray fine sand. On the rolling areas or on crests of slopes, a reddish shade is common. The soil is uniformly acid in reaction, the maximum acidity being in the sandy clay subsoil.

This is not a very extensive soil in this county. The principal areas are at Leggs Store, 3 miles northeast of Appleby, at Douglass, and 1 mile south of Woden. The areas are undulating or rolling and

occur on hilltops, upper slopes, and divides. About 70 per cent of the soil is in cultivation. Wooded areas are on the few steeper slopes.

Drainage is very good. Erosion is active, but it was not noted that the subsoil had been exposed to any great extent in cultivated fields. The soil is retentive of moisture, where proper terraces are maintained and a dust mulch is kept on the clean-cultivated fields. This is one of the best of the upland general-farming soils. The timbered areas support a good stand of pines and hardwoods.

The principal crops grown are cotton and corn, but small acreages are planted to the minor crops grown on Ruston fine sandy loam. Yields on the two soils are comparable under similar conditions. Fruit trees are productive, and an excellent quality of fruit is produced. The soil is suited to tomato culture.

From 150 to 300 pounds of fertilizer analyzing about 3–10–2 is used on cotton, although many farmers use similar amounts of superphosphate alone or lower-grade fertilizers. Corn is commonly grown without fertilization other than that derived from the nitrogenous and organic residues which accumulate in the soil after legumes are turned under or pastured off.

Land values range from $15 to $40 an acre, depending on improvements and distances from towns and transportation lines.

Deeper plowing, more diversification of crops, and the growing of more legumes are recommended for improving this soil. Other recommendations given in connection with Ruston fine sandy loam are also applicable.

Orangeburg fine sandy loam is capable of being maintained in a high state of productivity if it is properly managed. It responds readily to good management and is regarded, throughout the South, as one of the best upland general-farming soils. It is particularly adapted to cotton, cowpeas, peaches, fruits, and truck crops.

Orangeburg fine sandy loam, deep phase.—The deep phase of Orangeburg fine sandy loam, under forest conditions, consists of: (1) Dark-gray fine sand or loamy fine sand an inch or less thick; (2) pale yellowish-gray or grayish-yellow rather incoherent fine sand, which ordinarily shows a strongly reddish tint below a depth of about 15 inches; (3) red friable sandy clay, below an average depth of 30 inches. The underlying parent materials are the same as those under typical Orangeburg fine sandy loam, from which this phase differs only in that a deeper sand layer overlies the red sandy clay subsoil.

This soil occurs mainly in well-drained positions on upper slopes and divides. It very closely resembles Ruston fine sandy loam, deep phase, except that its subsoil is solid red and is slightly more friable, as a rule. In cultivated fields the soil is yellowish-gray fine sand. It is moderately acid in reaction, the highest acidity being found in the sandy clay subsoil.

This is not an extensive soil in this county. The principal areas are 4 miles north of Attoyac and 1 mile northeast of Linn Flat. The relief is undulating or rolling. About 50 per cent of the soil is in cultivation. The steeper slopes and unimproved areas are timbered. Drainage is good. Erosion is not so active as on typical Orangeburg fine sandy loam, because the upper sandy soil layers are not so deep

and the surface is somewhat less rolling. This is a drought-resistant soil and is one of the best general-farming upland soils in the county.

Crops grown, yields obtained, and methods of soil management used are essentially the same as on Orangeburg fine sandy loam. This soil, however, is not quite so well adapted to shallow-rooted crops or permanent pastures.

Land values range from $15 to $40 an acre, depending on improvements and location.

Orangeburg fine sandy loam, deep phase, is a good, durable soil, if it is well managed. In the South it is utilized profitably for the production of cotton, corn, forage crops, peaches, berries, and miscellaneous crops. It is a slightly better soil than Ruston fine sandy loam, deep phase, for most crops in average seasons.

GREENVILLE FINE SANDY LOAM

Greenville fine sandy loam, under forested conditions, consists of: (1) Dark reddish-gray or dark-gray fine sand, loamy sand, or fine sandy loam an inch or less thick; (2) red loamy fine sand or fine sandy loam, which in most places becomes more distinctly fine sandy loam and more intensely red at a depth ranging from 6 to 12 inches from the surface; (3) at an average depth of 12 or 15 inches, red friable sandy clay which in places contains a few fragments of yellow or ocherous sandy clay material, in the deeper subsoil below a depth of 2½ feet. As mapped in this county, the sandy clay subsoil is smooth friable sandy clay.

The partly weathered parent material of Greenville fine sandy loam is red friable sandy clay, 10 or 15 feet thick, through which are scattered remnants of ocherous sandy clay. The unaltered parent material was not seen, but it is believed to be very similar to that underlying the soils of the Nacogdoches series but to carry a higher percentage of sand. Small quantities of small iron concretions are present, in places, in both surface soil and subsoil. The whole soil mass is high in iron.

This soil occurs in only a few localities in this county, in association with the soils of the Ruston, Orangeburg, and Nacogdoches series. It closely resembles Orangeburg fine sandy loam, except that the red color characterizes the entire soil, and that more fine material is present in the upper layers. This soil differs from Nacogdoches fine sandy loam mainly in having a friable sandy clay rather than clay subsoil.

In cultivated fields, the soil is strongly red or reddish loamy fine sand or fine sandy loam. It is one of the most uniform of all the upland soils. It is moderately acid in reaction, the maximum acidity being in the subsoil. The soil is inextensive in this county. Areas are mapped at Linn Flat, near Leggs Store, at Nacogdoches, and 4 miles northeast of Nacogdoches. The relief is gently undulating or gently rolling. At Linn Flat, a considerable area occupies a plateaulike position on a broad divide. Other areas have gently sloping surfaces.

Drainage conditions are excellent. Internal water movement is unrestricted, and absorptive and retentive properties are nearly ideal. This is undoubtedly the best upland red-land soil in the county. Cot-

ton and corn are the chief crops. Cotton yields from one-third to 1 bale to the acre and corn from 15 to 30 bushels. The usual minor crops are grown satisfactorily. Although commercial fertilizers are not so commonly used on this soil as on the gray sandy-land soils, or fine sandy loams of the Norfolk, Ruston, and Orangeburg series, it has been amply demonstrated that moderate applications of suitable high-grade fertilizers on cotton and corn pay well. Yields of 75 bushels to the acre of corn have been grown on this soil in Smith County, by using nitrogenous fertilizers, increasing the supply of soil humus, and practicing thorough cultivation.

Land values range from $20 to $60 an acre, depending on the improvements and distance from towns and transportation lines.

Greenville fine sandy loam is regarded by many farmers as the best upland soil in the South, in the interior coastal plain formation. It is easily cultivated under a wide range of moisture conditions, is strong and durable, and responds quickly to improved soil-management methods. It produces good cotton, corn, leguminous crops, truck crops, peaches, plums, pears, and other crops.

NACOGDOCHES FINE SANDY LOAM

Nacogdoches fine sandy loam, under forest conditions, consists of: (1) Dark reddish-gray or dark brownish-gray loamy fine sand or fine sandy loam, with a conspicuous surface scattering of small pebbly dark-brown iron concretions; (2) red loamy fine sand or fine sandy loam containing a few small iron concretions and becoming typically heavy fine sandy loam between depths of about 8 and 12 inches; (3) below an average depth of 12 inches, red clay, not plastic unless very wet, but brittle, granular, and easily fractured, considerably more open and penetrable by water and plant roots than are most clays, grading into (4) below an average depth of 30 inches, yellow clay, more friable, well oxidized, but lacking the red color; (5) below an average depth of 5 or 6 feet, the partly weathered parent material, consisting of greenish or yellowish clay, containing tiny crystals of bottle-green glauconite, definite lines of parent material stratification or lamination, and shell casts; (6) below an average depth of about 8 or more feet, unweathered parent material consisting of yellowish or greenish clay containing numerous sea shells, glauconite crystals, and in places some thin beds of limestone and of lignitic material. This is known by geologists as greensand, greensand marl, or shell marl. The parent material of this soil also contains thin lenses or strata of ironstone or ferruginous argillite. The resistance to erosion of these rock strata is believed to account for the elevated position of the Nacogdoches soils in many parts of the county.

Except for local differences in the depth of the surface soil, this soil is fairly uniform. Inclusions are mainly small areas in which the red color does not show on the surface, but which are gray, like the surface soil of the associated Ruston fine sandy loam and other gray sandy-land soils. In a few small areas the surface soil is from 24 to 30 inches thick, rather than the customary 12 inches. A few small knolls and slopes of Nacogdoches gravelly fine sandy loam are also included. Near Nat and in two or three other places, small areas of closely associated soil were included.

Nacogdoches fine sandy loam, in cultivated fields, is red or reddish loamy fine sand or fine sandy loam. It is acid in reaction, markedly so in the clay subsoil. It is an extensive and important agricultural soil. The larger areas are between Douglass and Looneville, between Nacogdoches and Mahl, west of Melrose, near Shady Grove, and in the vicinity of Chireno. Smaller areas are of widespread occurrence in association with other Nacogdoches soils.

Areas are gently undulating, undulating, or gently rolling. The soil occurs in large plateaulike areas, on broad divides, and long gentle slopes. The steeper slopes are mostly timbered. Some forested tracts were mapped in large timbered tracts of other soils. This soil is smoother than most of the Ruston fine sandy loam and is somewhat more undulating, as a rule, than Greenville fine sandy loam, although a fair percentage of the area mapped has a gently undulating surface.

Drainage is good, despite the clay subsoil and substratum, although the rate of water movement downward is necessarily slower than in the friable sandy clays. Erosion is a serious problem on all the Nacogdoches soils, but perhaps is least so on this soil. (Pl. 3, A.) However, a great number of fields which, when originally cleared, were of this soil, have been so denuded of their sandy surface soils as to require classification as clay loams. Sheet wash removes large aggregate quantities of surface soil from fields of Nacogdoches fine sandy loam. Terracing is common but is not so widely practiced as it should be. Where properly terraced, this soil is retentive of moisture and is drought resistant. (Pl. 3, B.)

This is by far the most important red-land soil in the county and about 75 per cent of it is in cultivation. The timbered areas grow pine and the hardwoods common on the uplands, but the farmers state that hardwoods are more characteristic. Nearly all the soil has been cleared. Some of it is in pasture.

The principal crops grown are cotton and corn. Cotton yields from one-third to 1 bale to the acre and corn from 10 to 25 bushels. Cowpeas, velvetbeans, oats, and potatoes do well, as do also orchard fruits and berries. This is the preferred soil for early tomatoes, and good garden vegetables are grown on it. Tame pastures do well, if they are cared for. Dairying and hog raising are carried on, especially hog raising.

A large percentage of the more prosperous and progressive farmers of the county are located on Nacogdoches fine sandy loam. Farms and farm buildings are above the average for the county, and the soils are in correspondingly better condition, are more productive, and are better managed.

Fertilizers for cotton are in general use. From 200 to 400 pounds of 3–10–2 or 4–10–2 fertilizer is placed under cotton. Some farmers use small amounts of cottonseed meal or superphosphate, or both, and many use low-grade commercial fertilizers. The tendency has been toward a wearing out or burning out of the normal organic-matter content of these soils, until very recent years. More and better fertilizer is being used and more attention is given to soil conditions with a view to increasing productivity and drought resistance. Tomatoes receive from 500 to 800 pounds of complete fertilizer of 4–10–4 formula, with subsequent side dressings of

nitrate of soda for forcing the vegetative growth, if needed. Barnyard manure is used mainly in gardens.

Land values range from $20 to $60 an acre, depending on improvements and location.

Nacogdoches fine sandy loam is a strong, durable soil, is easily tilled under a wide variation of moisture content, is well drained and well oxidized, and is of suitable relief for the use of modern machinery and tractors. It is probably the most important and most valuable soil in the county for the production of cotton, peaches, and tomatoes and is suited to a wide range of crops and livestock enterprises. The methods of soil management and the crop rotation recommended for the improvement of Ruston fine sandy loam are applicable also to this soil.

NACOGDOCHES GRAVELLY FINE SANDY LOAM

Nacogdoches gravelly fine sandy loam, under forest conditions, differs from Nacogdoches fine sandy loam mainly in that it has a high content of dark-brown, small pebbles of iron concretions on the surface, in the surface soil, and in the subsoil. The parent materials are the same as in the fine sandy loam, except that they contain more iron in the form of strata or fragments of ironstone and concretionary iron oxides.

The agricultural significance of the numerous concretions, fine gravel, and rock fragments in the surface soil and subsoil is that they increase the porosity of these layers to some extent. The soil is variable in its content of fine, gravelly, ferruginous materials, and the line of separation between it and the adjoining Nacogdoches soils is necessarily vague and indistinct in places. There are small included areas of the fine sandy loam, clay loam, and gravelly clay loam of the Nacogdoches series, as well as of Ruston fine sandy loam.

In cultivated fields, this soil is red or brownish-red gravelly fine sandy loam. It is moderately acid in reaction, the deeper clay subsoil showing the maximum acidity.

This is an important and extensive soil. The largest areas are between Nacogdoches and Appleby, near Dalmont, 2 miles northwest of Douglass, and west of Shady Grove. The areas are undulating, gently rolling, or rolling, and a few are hilly. The soil most commonly occurs in fairly large areas on divides and slopes of intermediate gradient. Scattered small areas occur in association with the Ruston and other soils. The steeper slopes are in timber of pine and upland hardwoods. Drainage is good, internal drainage being better and more rapid than in Nacogdoches fine sandy loam, on account of the presence of gravel. Some rolling areas are said to be droughty. It was noted that these fields were poor in organic matter and had been planted to cotton for many successive years. The soil is fairly drought resistant, except a few very gravelly areas.

Erosion is a serious menace to the maintenance of this soil in a productive condition. A large number of areas formerly of gravelly fine sandy loam texture to plow depth had to be classified as gravelly clay loam, because the original sandy surface soil had been washed away and the soil turned up by the plow was in reality largely subsoil.

This is the important gravelly red-land soil of the county. About 60 per cent of it is in cultivation. Crops grown are principally cotton and corn. Cotton yields from one-third to 1 bale to the acre and corn from 10 to 25 bushels. Most of the common minor crops do fairly well. Like Nacogdoches fine sandy loam, this is a desirable soil for general and dairy farming and is superior for cotton, peaches, tomatoes, and garden vegetables. The presence of fine iron concretions, or "cotton grit," does not impair its utility but is rather a benefit, as a surface mulch is more easily obtained. This is one of the earliest soils in the county.

Land values range from $15 to $60 an acre, depending on improvements and distance from towns and transportation lines.

The productive capacity of this soil could be increased by terracing and contour plowing. The growing of more legumes in suitable rotations is recommended.

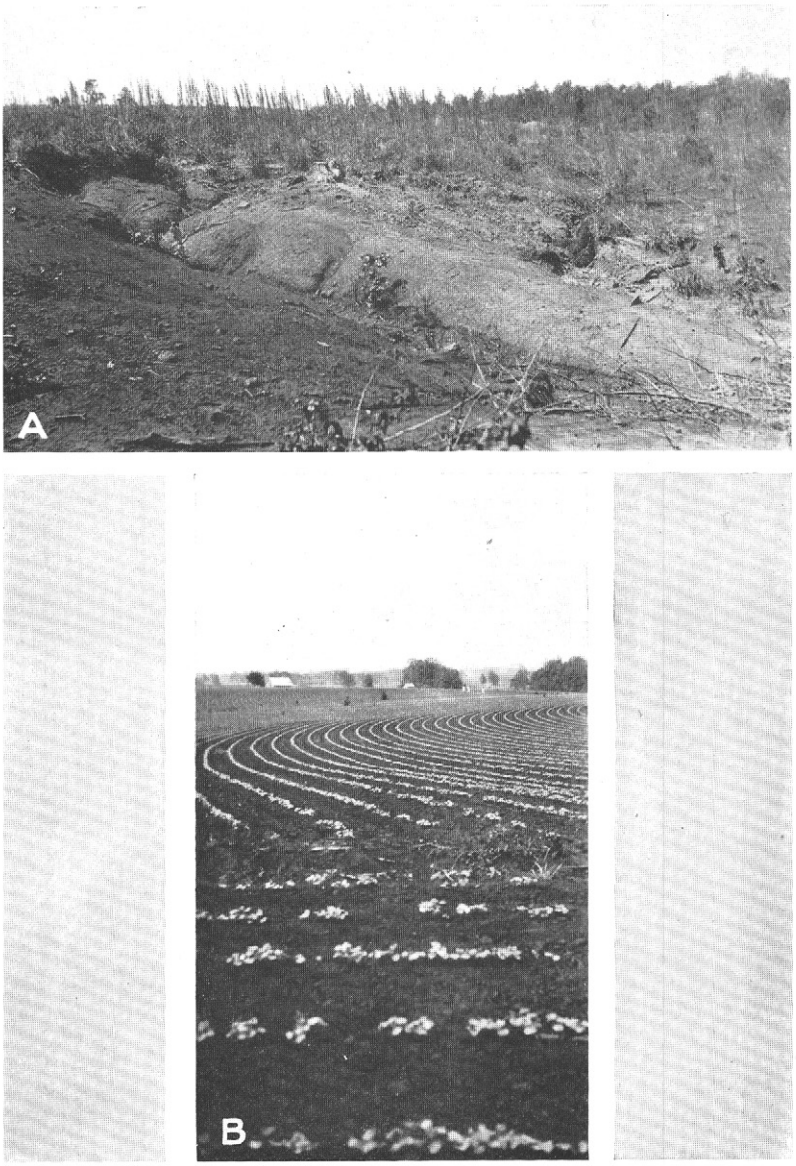
NACOGDOCHES CLAY LOAM

Nacogdoches clay loam, under forest conditions, consists of: (1) Dark-gray or dark grayish-red loamy fine sand or fine sandy loam an inch of less thick; (2) red loamy fine sand, fine sandy loam, or heavy fine sandy loam 2 or 3 inches thick; (3) red clay, brittle rather than plastic, continuous to a depth ranging from 24 to 30 inches before noticeable traces of the deeper-lying beds of yellow or ocherous-yellow clay are seen; (4) ocherous-yellow brittle clay, several feet thick, underlain at a depth varying from 6 to 12 feet by the greensand or shell marl parent material characteristic of the series.

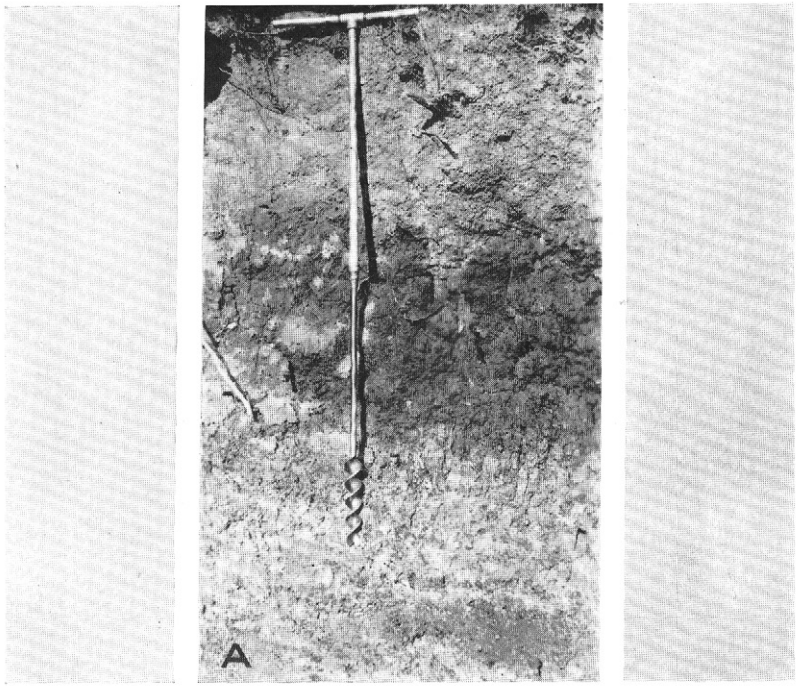
Less gravel and concretionary material are present on the surface and in the surface soil and subsoil of this soil than of any of the other Nacogdoches soils. In many places, almost no concretionary material is present. Also, rock strata of ironstone are comparatively uncommon, except on the steeper slopes where they outcrop in many places.

In cultivated fields, this soil to plow depth is a mixture of the shallow fine sandy loam layer and a small part of the natural clay subsoil and averages clay loam in texture. In flatter areas, it has in many places a dark-red color. In depressions and on some of the lower slopes at stream heads, the surface soil is chocolate brown and the subsoil is yellow rather than red. Such areas, where of sufficient size, were mapped as Wilson clay loam. The surface soil and subsoil are acid in reaction.

This is a rather extensive, well-developed, and important soil. The principal areas are north and west from Chireno, 2 miles north of Nacogdoches, and in the neighborhood of Oak Ridge School. Except for local differences in the depth of the sandy surface layers, in the quantity of gravel present, and in color, the soil is fairly uniform. The relief is mainly gently undulating or gently rolling. Some moderately rolling areas which are high in gravel content have been classified as Nacogdoches gravelly clay loam. Nacogdoches clay loam has a comparatively smoother surface relief than the gravelly Nacogdoches soils, but it is, as a rule, less smooth than Nacogdoches fine sandy loam. Wooded areas support a mixed forest growth.



A, Stream-head erosion on Nacogdoches fine sandy loam; B, contour-bedded cotton on Nacogdoches fine sandy loam



A, Profile of Kirvin fine sandy loam; B, growth of cypress, water elm, and Spanish moss on Bibb clay loam around Salt Lake

Regional drainage is good, as a whole, but is inclined to be sluggish in some of the flatter areas. Internal water movement is slower than in any other Nacogdoches soil. The run-off is rather rapid, as the clay subsoil absorbs water slowly.

Erosion, especially sheet wash, has been very active in many fields. Many cultivated areas would have been classified as Nacogdoches fine sandy loam in the virgin condition.

This is the important heavy red-land soil of the county. About 65 per cent of it is in cultivation. Cotton and corn are the chief crops grown. Yields range from fair to very good, depending on the care given the crops and the condition of the soil. Cotton yields from one-quarter to 1 bale to the acre and corn from 15 to 35 bushels. Cowpeas, velvetbeans, sorghums, oats, and tomatoes are grown successfully, and small fruits are produced to some extent. Heavier implements are required for handling this soil than are needed on the sandy-surfaced upland soils. This is the heaviest of the Nacogdoches soils of the county and is very strong and productive. Pastures do well, and the soil is suited to dairying.

It is especially advisable, for many reasons, to keep up the supply of organic matter in this soil. One of the most important benefits obtained is to increase the ability of the soil to absorb moisture quickly. The presence of fresh organic matter will make available for plants the large stores of mineral plant food contained in the surface soil and upper part of the subsoil. Large applications of complete fertilizer are not necessary if deeper plowing is practiced and cover crops are grown for soil-building purposes, in connection with a suitable crop rotation. The use of lime is suggested as a means of improving tilth, as this soil has a lime requirement of 1 ton or more to the acre. Applications of 200 or 300 pounds to the acre of superphosphate under the cotton crop have produced excellent yields. A number of progressive farmers on this soil practice diversified farming, with cotton, vegetables, fruits, hogs, and dairy and poultry products as the cash crops and corn, oats, sorgo, and legumes as subsistence crops.

Land values range from $20 to $60 an acre, depending on improvements and distance from towns and transportation lines.

Nacogdoches clay loam is one of the best medium-late truck and general-farming soils of the coastal plains of the South. Such truck crops as cauliflower, spinach, kale, eggplant, carrots, parsnips, potatoes, tomatoes, onions, cabbage, celery, beets, and cucumbers give the best results. Strawberries, blackberries, and raspberries do well. As this is not an early trucking soil, the vegetables are largely grown for canning. Very good yields of cotton, corn, cowpeas, velvetbeans, crimson clover, vetch, and sorghum are obtained on soil similar to this elsewhere in the South in the same climatic belt. In favorable seasons, good yields of sugarcane are obtained, but the sirup is darker colored than that obtained from cane grown on sandy soils. Small grains and grasses do well, and and oats and rye, Bermuda, Lespedeza, and bur clover flourish. The soil responds readily to systems of soil improvement and is easily maintained in a good state of productivity.

NACOGDOCHES GRAVELLY CLAY LOAM

Nacogdoches gravelly clay loam, under forest conditions, differs from Nacogdoches clay loam in that more dark-brown iron concretions are on the surface and in the upper soil layers and in that ferruginous rock fragments are more common. In wooded areas, this soil consists of: (1) Dark grayish-red loamy gravelly fine sand or fine sandy loam an inch or less thick; (2) a 2 or 3 inch layer of red gravelly fine sandy loam or heavy fine sandy loam which, like the surface sandy layer, is lacking in places on eroded slopes; (3) between average depths of 4 and about 24 inches, red clay, brittle rather than plastic, grading into (4) yellow or ocherous-yellow brittle clay, several feet thick, underlain at a depth varying from 4 to 10 feet by (5) greenish-yellow clay containing glauconite and shell casts in the upper part and the unaltered shell-bearing calcareous greensand or glauconitic shell marl below. Thin decomposing and well-fractured seams of ferruginous rock, yellow, reddish, or brownish in color, are seen in many places in the surface soil and subsoil. The surface soil contains large quantities of small brown iron concretions which, together with small rock fragments, give to it a gravelly texture.

More rock is scattered about the surface and crops out on the slopes of this soil than of any other important soil in the county. In many places erosion has been so active that the red color distinctive of the better-weathered Nacogdoches soils has either never had opportunity to develop or the red materials have been washed away, so that the soil above the parent materials is in places yellowish rather than red.

This soil is variable in its content of gravelly and stony materials. There are small inclusions of associated Nacogdoches soils and some of Kirvin soils, which commonly occur in thin streaks around slopes. Some small areas of Susquehanna fine sandy loam and Susquehanna clay loam occurring on lower slopes were included. Another inclusion consists of narrow bands or strips of Wilson clay loam. Small areas of other dark-red or chocolate-red soils were also included.

Only about 10 per cent of this soil is in cultivation, owing to its steep relief. The cultivated soil is red gravelly clay loam. Both surface soil and subsoil are strongly acid. The soil is not very extensive and is comparatively unimportant agriculturally. The principal areas are on the slopes of the prominent hills near Swift, on the slopes of Floury Mountain, 2 miles north of Cushing, and 3 miles northwest of Shady Grove. The relief is rolling, steeply rolling, or hilly, and most of the soil is not suited to cultivation. The cleared fields are mainly on the smoother, lower slopes.

Drainage is good or excessive. Erosion is very active, and cultivated fields must be terraced and plowed and bedded in contoured rows. Some cotton and corn are grown. Yields are fair or good, depending on the protection given against too rapid run-off, on the maintenance of a surface mulch, and on care and fertilization.

Most of this soil is better suited to timber and pasture than to cultivated crops. The lower slopes and less-rolling areas may be made highly productive, however, when the content of organic matter

is maintained and good farming practices are followed. The gravelly texture of the soil is not considered a hindrance to cultivation, except in a few places where excessive quantities are present. The soil is inclined to be droughty in long dry periods during the growing season unless underground water conditions are particularly favorable.

Land values range from $10 to $35 an acre, depending on location and improvements.

KIRVIN FINE SANDY LOAM

Kirvin fine sandy loam, in the virgin condition, consists of: (1) Dark-gray loamy fine sand or fine sandy loam from 1 to 3 inches thick; (2) yellowish-gray, pale-yellow, or reddish loamy fine sand from 7 to 9 inches thick; (3) red heavy clay, brittle when dry and plastic when wet, high in content of colloids, and of varying thickness but averaging from 12 to 18 inches or continuing to a depth ranging from 24 to 30 inches; (4) red, yellow, and in places slightly gray mottled plastic heavy clay high in colloids and several feet thick; (5) the underlying unchanged parent material of laminated, slightly indurated reddish, yellowish, gray, and light-gray clay, in which the light gray is the predominating shade. (Pl. 4, A.) Where these parent material beds occur in massive forms, as in the southeastern part of the county in the vicinity of Etoile, no soils other than those of the Kirvin series may occur for several miles. The effect of the position of outcrops of interbedded strata of this kind in other beds of sandier material occur where scattered areas of Kirvin fine sandy loam are shown. When parent materials of upland sedentary soils are considerably assorted, that of the Kirvin soil is commonly though not everywhere found in the lowest position on the slopes.

Numerous small iron concretions are scattered over this soil, especially on knolls and spurs where the soil is better oxidized and tends to approach Nacogdoches fine sandy loam in character. A gravelly phase of this soil was not mapped in this county, although there are numerous scattered small areas containing thin seams of ferruginous sandstone and, in places, enough broken and decomposing rock fragments and concretions to almost require a gravelly or stony phase classification. Most of this stone-bearing Kirvin fine sandy loam is located in woodlands and is of little significance.

This soil is rather variable, especially in regard to thickness of upper sandy layers, color of subsoil, and relief. Commonest inclusions are small areas or knobs of Nacogdoches fine sandy loam, Nacogdoches gravelly fine sandy loam, Susquehanna fine sandy loam, and Susquehanna clay loam. About stream heads and flatter lower slopes areas of poorly drained soil similar to the Susquehanna are included.

As the thickness of the sandy surface soils depends to some extent on slope and extent of erosion, the depth to the clay subsoil varies considerably from place to place. The subsoil colors, to a depth of about 3 feet, are inclined to be prevailingly red or dull red, mottled with yellow in the lower part on the better-drained and more exposed positions. On the flatter surfaces, the red subsoil color is in many places a subdued tint, with yellow and in places gray as the primary

colors of the mottled clay lower subsoil mass. In these areas, the upper subsoil layer is very poorly developed.

The lines of separation between this soil and associated soils, such as Kirvin clay loam, Ruston fine sandy loam, Bowie fine sandy loam, and the soils of the Lufkin series, are in many places arbitrarily drawn. A few small areas of Cuthbert fine sandy loam were included in mapping as were also a few areas of Kirvin fine sandy loam, mound phase. This included Kirvin soil is very similar to Kirvin fine sandy loam in general characteristics and utilization. The areas are nearly flat or gently undulating, but the surface configuration is very conspicuously marked by mounds from 2 to 5 feet higher than the intermediate depressions. The mounds consist of yellowish-gray fine sand, with a slight surface organic layer of dark-gray fine sand or loamy fine sand, in the wooded areas. The subsoils, below a depth ranging from 2 to 5 feet, are variable and consist mostly of reddish-yellow or yellow sandy clay or denser clayey material of similar color but generally resembling the clay subsoil of Kirvin fine sandy loam. The soil between the mounds is commonly typical Kirvin fine sandy loam or a poorly drained variation in the lower places.

In cultivated fields, this soil is gray or dark-gray fine sand, loamy fine sand, or fine sandy loam. In old fields, the soil is gray. In rolling areas, the red subsoil comes to the surface in places. The soil is very acid, especially in the clay subsoil.

This is an extensive soil but is not very important agriculturally, because only a comparatively small percentage is in cultivation. The largest areas are in the southeastern tip of the county, in the vicinity of Garrison, in the vicinity of Caro, and east of Shady Grove. There is a rather large area near Attoyac, and numerous smaller areas are in many parts of the county.

The relief is variable. Large gently undulating or gently rolling areas are on the broader divides and ridges and long slopes. Other large areas, largely wooded, are rolling or hilly.

Surface drainage is good or fairly good, but internal drainage is fair or poor, being influenced by the dense, plastic, heavy clay subsoil. In places where the upper sandy layers are thicker than usual, internal drainage for shallow-rooted crops is fair, but water movement through the clay subsoil is very slow.

Prevention of erosion is important on all sloping cultivated fields. Many have lost a large part of the original sandy covering over the clay subsoils, owing to the effects of torrential rains. On all rolling and hilly areas, the amount of rain water absorbed is low, because of the quick run-off. During long rainy periods, common in the winter months, the clay mass becomes saturated to a considerable depth and is very sticky and puttylike. Roads made up of Kirvin clay material, particularly through the flatter areas, may then become impassable for weeks at a time. When dried out, the clay subsoils crack deeply, with a coarse-granular structure and polygonal joint planes. This is not a drought-resistant soil, except on lower slopes and positions favorable for the accumulation and retention of moisture or where the water table is comparatively high during droughts. Conversely, during wet growing seasons the more gently sloping fields become wet or seepy and are too poorly drained to produce crops well.

About 15 per cent of this soil is in cultivation. Forested areas are very extensive. Some pines grow on the soil, but it is known as post-oak land, as this tree thrives especially. The mixed forest most common consists of shortleaf pine; white, red, black, and post oaks; hickory; gums; and other hardwoods. The chief crops are cotton and corn, but cowpeas, oats, and garden vegetables are also raised. Cotton yields from one-quarter to one-half bale to the acre and corn from 10 to 20 bushels.

This is not a very productive soil and is not especially well suited to deep-rooted crops requiring well-drained subsoils. Although peaches are short-lived, they are grown to a minor extent. Cotton does better than any other crop, except possibly oats and the grasses. This is a good pasture soil. Large areas are suited for timber and pasture rather than the miscellaneous crops of this locality.

Some cotton is grown without fertilizers. Very frequent cultivations are necessary, and the land must be comparatively well supplied with organic matter, if satisfactory yields are to be obtained. The use of commercial fertilizers is increasing. Some cottonseed meal is used for both cotton and corn. For cotton, from 150 to 300 pounds of a 3–10–2 formula is used by the better farmers. A number of farmers use the lower grade 1.65–10–1 fertilizer, and some use small amounts of superphosphate alone. Ridge cultivation is used for cultivated crops.

Land values range from $5 to $30 an acre, depending on improvements and location with reference to markets and transportation lines.

This is not regarded as a good general-purpose soil. A large percentage of the soil is submarginal, in the sense that it will not, in average seasons and with average care, produce sufficiently good crops to provide good wage returns to the farmer. Parts of the soil, including the deeper smoother areas with red subsoils, are fairly good crop land. These may be improved by adopting methods used by progressive farmers. The growing of winter cover crops in connection with a rotation, terracing, and deeper plowing are recommended. Bermuda grass thrives. Improvement of pastures, in connection with dairying and beef production, is suggested as a better utilization than miscellaneous cropping under the prevailing methods in common use in the county.

Kirvin fine sandy loam, deep phase.—The deep phase of Kirvin fine sandy loam, under forest conditions, consists of: (1) Loamy fine sand or fine sandy loam from 1 to 3 inches thick; (2) pale grayish-yellow or pale-yellow fine sand or loamy fine sand continuing to an average depth ranging from 15 to 30 inches; (3) red, plastic, heavy clay high in colloids and mottled with yellow and gray; (4) below an average depth of 36 inches red, yellow, and gray, mottled, plastic heavy clay high in colloids and several feet thick, which becomes more predominantly light gray in color with depth; (5) the parent materials, of light-gray laminated clays similar to the beds underlying Kirvin fine sandy loam.

This soil is comparatively uniform. Some areas of the associated Kirvin fine sandy loam and its mound phase are included, and in places, especially in the flatter areas, there is a tendency for this soil to have a somewhat billowy or moundy surface, owing to greater or less depth of the upper sandy layers.

In cultivated fields, the soil is gray or dark-gray fine sand or loamy fine sand. It is not so spotted as are fields of Kirvin fine sandy loam. The soil gives an acid reaction, the deeper clay subsoil being very acid.

This is not an extensive soil, but a comparatively larger percentage of it than of the other Kirvin soils is in cultivation. The largest areas are 1 mile west of Fern Lake, 2 miles south of Nacogdoches, and near Flatwoods School. The relief is gently undulating or gently rolling. The soil occurs most commonly on broader divides or smoother uplands or hilltops, surrounded by or associated with Kirvin fine sandy loam. It is also found on some of the longer gentle slopes.

Surface drainage is fairly good and internal drainage is fair for shallow-rooted crops, but deeper internal drainage is slow and somewhat unsatisfactory on account of the heaviness and plasticity of the clay subsoil. Prevention of erosion is important on all sloping fields. This is a fairly retentive and drought-resistant soil. Forested areas support approximately the same timber growth as is found on Kirvin fine sandy loam.

About 20 per cent of this soil is in cultivation. Cotton and corn are the chief crops, but cowpeas, velvetbeans, sorghum, oats, and some other minor crops are grown with fair success. Cotton yields from one-quarter to one-half bale to the acre and corn from 10 to 25 bushels. This is a fairly productive soil, recognized as better than typical Kirvin fine sandy loam because the undesirable heavy and comparatively impenetrable, highly acid clay subsoil lies at a depth ranging from 15 to 30 inches below the surface. Of all crops grown, cotton does best. Fertilization and management are the same as for Kirvin fine sandy loam, and the recommendations for the improvement of that soil apply to this.

This soil commands from $8 to $35 an acre, depending on farm improvements and distance from lines of transportation and from towns.

KIRVIN CLAY LOAM

Kirvin clay loam, under forest conditions, consists of: (1) Dark-gray loamy fine sand or fine sandy loam an inch or two thick; (2) to an average depth between 3 and 5 inches, yellowish-gray or dark-yellow loamy fine sand, fine sandy loam, or heavy fine sandy loam; (3) red, heavy clay, brittle when dry and plastic when wet, high in colloids, and continuous to a depth ranging from about 12 to 24 inches; (4) red, yellow, and gray mottled, plastic heavy clay high in colloids, which becomes less red and more gray with increasing depth; (5) the unweathered parent material, occurring below a depth ranging from 2 to 5 feet, of light-gray, heavy, laminated, massive clay beds. In a few places small brown iron concretions are scattered over the surface and in a few places, on abrupt slopes, caps, and knobs, numerous ironstone fragments were present in surface soil and subsoil.

This soil is variable in relief. Some areas are nearly flat or gently undulating, large areas are rolling, and some are steep. A large area of the soil is around La Cerda, another is 2 miles northwest of Etoile, one is northeast of Nacogdoches, and smaller areas are in many parts of the county.

Inclusions consist of small areas of Kirvin fine sandy loam and of poorly drained soils of the Susquehanna and Lufkin series occurring in a few depressions. The subsoil colors are more distinctly red on the better-drained or hillier positions than in the flatter areas. In the few cultivated fields the soil is dull-reddish clay loam, being a mechanical mixture, to plow depth, of the thin sandy surface soil and a small part of the red clay subsoil. The soil is highly acid.

Surface drainage is poor on the flatter areas and good in the more rolling sections. Internal drainage is poor. Roads are impassable after long periods of wet weather. The soil dries out and cracks deeply during drought. Very little of the soil is in cultivation. Cotton is the chief crop. None of the deeper-rooted crops thrive, and fruit trees do not do well. This is a particularly difficult soil to cultivate on account of the nearness to the surface of the plastic heavy clay subsoil. Farmers call it "red rawhide land" or "clay gall." As Bermuda grass does fairly well, the soil has possibilities in connection with cattle raising. In timber it supports a fair growth of post and other oaks, upland hickories, and some pine.

This is considered a nonagricultural or submarginal soil, best adapted to timber and pasture.

BOWIE FINE SANDY LOAM

Bowie fine sandy loam, under forest conditions, consists of: (1) Dark-gray fine sand or loamy fine sand an inch or two thick; (2) to an average depth of 12 or 15 inches, pale-yellow or pale grayish-yellow fine sand or loamy fine sand; (3) moderately friable yellowish sandy clay; (4) below an average depth of about 30 inches, heavy yellow sandy clay, somewhat mottled and blotched with red; (5) more tenacious clay material which becomes more conspicuously mottled with red and gray below a depth of 36 inches; (6) below a depth of 4 or 5 feet the unaltered parent material consisting of varicolored grayish or yellowish laminated heavy sandy clay.

This soil occurs in many places in an intermediate position between the soils of the Norfolk, Ruston, and Kirvin series and more or less blends with them, making the drawing of soil boundaries difficult. In cultivated fields the soil is dark-gray or gray fine sand or loamy fine sand. It is acid in reaction, especially in the deeper subsoil.

This soil is inextensive. In the vicinity of Garrison, it occurs in scattered, irregular-shaped areas on the crests of hills. Most of the soil occurs in the northeastern part of the county. A few flatter areas resembling Caddo fine sandy loam were included in mapping.

This soil as a whole is gently undulating or gently rolling. Some of the larger areas are on broad divides and gentle slopes. Mounds are common. Drainage is fair or good, except on flatter areas where it is distinctly sluggish. Erosion is active on unterraced sloping fields. The soil is retentive of moisture, and most of the fields in cultivation have proved drought resistant, maintaining crops in good growing condition during drought much better than many of the upland soils of the county. Some areas are rather cold and late in rainy springs.

This is a fairly important gray sandy-land soil. About 40 per cent of it is in cultivation. The forest is of pine; white, red, and post oaks; hickories; and other trees. This is a good timber soil, but most of the areas are suitable for agriculture.

Crops grown are cotton and corn, principally, with smaller acreages of cowpeas, oats, sorgo, and garden vegetables. Cotton yields from one-third to 1 bale to the acre and corn from 15 to 30 bushels. This is a fairly good fruit soil. Farming methods in common use are about the same as on Ruston fine sandy loam, except that this is a later soil.

Land values range from $15 to $40 an acre, depending on farm improvements and location. This soil, in most seasons, produces good crops of cotton, corn, and other crops. The subsoil is reasonably friable, and at the same time is tenacious of its absorbed moisture and is very drought resistant. This is a good general-farming soil. Recommendations given for improvement of Ruston fine sandy loam apply also to this soil.

LUFKIN LOAM

Lufkin loam is shown on the accompanying soil map in scattered small, flat areas occupying poorly drained depressions, sloughs, marshy stream-head spots, and similar locations where the water table ordinarily stands so high as to inhibit normal movement of soil water. There is no profile development for two reasons, that this soil is being built up by deposition from wash from higher land and that the presence of excess water in the soil for the greater part of the year brings about deoxidation rather than allowing normal weathering processes to continue.

This soil is dark gray on the surface, owing to the presence of organic matter. Below a depth ranging from 8 to 15 inches, the subsoil becomes drab, gray, or light ash gray in color, mottled with brown, yellow, and orange. The textures included in this grouping are fine sand, fine sandy loam, very fine sandy loam, and clay loam, in the surface soil, underlain by clay loam or clay. In places the mottling extends through to the surface.

This soil is of very small extent and none of it is cultivated. It is known as "post-oak flats." Water, pin, and willow oaks; water elm; and willows are the principal trees. Water frequently remains in ponds after rains. The soil has little or no value except for timber and for the pasturage it affords.

WILSON CLAY LOAM

Wilson clay loam, in the virgin condition, consists of: (1) Dark-gray or nearly black clay loam from 12 to 15 inches thick; (2) yellow moderately plastic clay, extending to a depth of 4 or 5 feet below the surface, where it is underlain by (3) yellowish or pale greenish-yellow calcareous shell-bearing clay or greensand marl. The parent material is similar to that of the Nacogdoches soils. In fact, this soil is invariably associated with the Nacogdoches soils, which are everywhere adjacent to and above it. This soil is most closely associated with Nacogdoches clay loam. It is the only upland agricultural soil having a thick, highly organic layer. The combination of calcareous

parent materials fairly close to the surface and suitable moisture conditions for rank vegetative growth are responsible for the presence of the organic matter.

In cultivated fields this soil is also dark-gray or nearly black clay loam. To a depth of 3 or more feet, it is acid or slightly acid in reaction. Acidity decreases with depth, and the deeper part of the subsoil becomes calcareous below a depth of 4 or 5 feet.

This soil is very inextensive, but 75 per cent of it is in cultivation. Areas are mapped 1 mile west of Oak Ridge School, 3 miles south of Morgan Store, and near Appleby. Included in mapping are a few areas in which both surface soil and subsoil are of clay texture and a few small areas of brown clay loam with a yellow subsoil.

The relief is gently sloping or nearly flat, the soil occurring in pocketlike areas in Nacogdoches clay loam or on lower slopes between the Nacogdoches soils and stream bottoms. Drainage is good in most areas but is sluggish in the flatter spots, where water may stand for a period after rains. Internal drainage is fairly good. Erosion is not a serious problem.

This is the so-called black prairie or " haw-bush " prairie land found in a few places in the county. The original growth seems to have been largely hawthorn trees and grasses, though some of the soil supports a stand of mixed hardwoods.

Crops grown are principally cotton, corn, cowpeas, and sorgo. Cotton yields from one-half to 1 bale or more to the acre and corn from 20 to 40 bushels. This is a very productive soil and is rich in organic matter. Where frequently cultivated, it produces large yields of cotton and corn without fertilization. Apparently it will not require large amounts of fertilizers for some years, provided crop rotations, including legumes, are followed in order to maintain the content of organic matter and keep the physical condition good.

Land values are from $30 to $60 an acre, depending on location and improvements.

SUMTER CLAY

Sumter clay, in the virgin condition, consists of dark-gray plastic clay, from 6 to 12 inches thick, typically containing some scattered white or yellowish lime concretions, underlain by yellow or greenish-yellow calcareous plastic heavy clay, several feet thick, which is high in colloids and contains numerous lime concretions, some shell, and soft masses of white limy material. This soil is probably only very slightly weathered parent material, in which organic matter darkens the upper part.

The relief is rolling. The soil occurs only in a few wooded areas in association with Kirvin clay loam. It has been derived from shell-bearing parent material clays, which are otherwise apparently identical with the beds underlying the Kirvin and Susquehanna soils. It is, similarly, so tough and plastic that it is unsuited for cultivation. It is comparable to Kirvin clay loam in value and utilization.

KALMIA FINE SAND

Kalmia fine sand, under forest conditions, consists of: (1) Dark-gray fine sand or loamy fine sand an inch or less thick; (2) pale-yellow rather incoherent fine sand, extending to a depth of several

feet. The soil has been derived from old alluvium of prevailingly fine sand texture. It resembles Norfolk fine sand in profile and in utilization. It is slightly acid or neutral in reaction.

This soil occurs on river terraces, on flat-topped benches from 10 to 25 feet above the first bottoms. It is penetrated to some extent by the erosion lines of small streams but is, as a rule, uniform in texture and is prevailingly level or very gently sloping in relief.

Kalmia fine sand is not extensive. The principal areas are 4 miles southwest of Sacul, 4 miles west of Lilbert, and 3 miles southeast of Poe. About 20 per cent of the soil is in cultivation. Drainage is excellent. The native vegetation consists of pines; blackjack, white, red, and post oaks; holly; dogwoods; and gums.

Crops grown are cotton, corn, and cowpeas. Newly cleared fields are productive for a few years, but yields decrease with continued cropping unless fertilizers are used. Cotton yields from one-quarter to one-half bale and corn from 8 to 20 bushels to the acre.

This is a somewhat droughty soil but is capable of much improvement. Deeper plowing and the turning under of legumes and cover crops are recommended. The smooth, fairly level surface makes for easy culture. The soil is suited to the production of numerous field crops and early truck crops, fruits, and berries.

All areas of this soil are rather distant from towns and shipping points. Land values range from $10 to $30 an acre.

KALMIA FINE SANDY LOAM

Kalmia fine sandy loam, under forest conditions, consists of: (1) Dark-gray fine sand or loamy fine sand an inch or less thick; (2) pale-yellow fine sand which becomes more intensely yellow with depth; (3) between depths of 12 or 15 inches and 36 or more inches, heavy, friable yellow fine sandy loam or light sandy clay; (4) light, porous sandy clay beds uniform in texture and yellow in color.

This soil occurs mainly along and adjacent to the bottoms of Angelina River and Attoyac Bayou, on terrace benches standing from 10 to 25 feet above the bottom levels. The relief is flat or nearly flat. The surface configuration is smooth but is varied in places by small stream courses and sinuous depressions which are doubtless remnants of old sloughs or former watercourses formed when the present terraces were at bottom level.

This soil very closely resembles Norfolk fine sandy loam, except that the layers are not so sharply marked and that the surface is smoother. Drainage is good. The soil is acid in reaction, especially in the subsoil.

Kalmia fine sandy loam does not cover a large aggregate area of the county, but it is one of the more extensive terrace soils. The principal areas are 2 miles north of Spanish Bluff, 2 miles south of Leggs Store, and 2 miles east of Smyrna School. Pine and mixed hardwoods constitute the forest growth.

About 50 per cent of this soil is in cultivation. Cotton and corn are grown. Cotton produces from one-quarter to three-quarters bale and corn from 10 to 25 bushels to the acre. Some farmers have cultivated this soil for a number of years successively to clean-cultivated crops, and yields on many fields are therefore low. The

relief is favorable for the use of modern farm implements. The soil is suited to a wide range of crops, its adaptabilities being comparable to those of Norfolk fine sandy loam. Methods of soil management for increasing productivity should include deeper plowing and increasing the supply of organic matter. Rotating crops and the use of moderate quantities of high-grade commercial fertilizers are recommended. Suggestions given in connection with methods of improving the productivity of Norfolk fine sandy loam apply also to this soil.

Kalmia fine sandy loam is one of the best general-purpose soils in the county. Land values range from $10 to $30 an acre, depending on farm improvements and distance from towns and transportation lines.

Kalmia fine sandy loam, deep phase.—Kalmia fine sandy loam, deep phase, differs from Kalmia fine sandy loam in that the upper fine sand or loamy fine sand layers are from 15 to 30 inches thick above the yellow, heavy fine sandy loam or sandy clay subsoil.

This is not an extensive soil, but it is one of the principal terrace soils. It occurs in association with typical Kalmia fine sandy loam, which it resembles also in position, elevation, and relief. The surface configuration is inclined to be slightly hummocky or billowy in places. The soil is moderately acid, especially in the subsoil. The native forest is pine and mixed hardwoods. Drainage is good.

Areas of this soil are west of Blounts Lake, 2 miles north of Durst Lakes, and near Etoile. About 50 per cent of the soil is in cultivation. Some very good farms are located on it. Cotton, corn, cowpeas, sorgo, oats, melons, peanuts, vegetables, and fruits are grown. Cotton yields from one-quarter to three-quarters bale to the acre and corn from 10 to 25 bushels.

This soil is comparable to the upland Norfolk fine sandy loam, deep phase, of which this is the terrace equivalent. The means of improvement suggested for that soil apply also to this.

Land values range from $10 to $30 an acre.

Kalmia fine sandy loam, rolling phase.—This classification was made to provide a convenient grouping for the rolling edges and eroded slopes of the higher terraces of the Kalmia soils. The profile is the same as that of Kalmia fine sandy loam, and the parent material of old alluvium is identical. Included with this soil is a narrow belt consisting of rolling, steeply rolling, and eroded edges of the Cahaba terraces. In profile this soil is identical with Kalmia fine sandy loam, rolling phase, differing only in the color of the subsoil, which is reddish yellow. This inclusion is of very minor extent and is all wooded.

The areas of this soil are rolling or steeply rolling. The soil is of very small extent in this county. It occurs in narrow strips near the mouth of Bernalda Creek. It is almost entirely in woodland and pasture.

CAHABA FINE SANDY LOAM

Cahaba fine sandy loam, under forest conditions, consists of: (1) Dark-gray fine sand or loamy fine sand an inch or less thick; (2) pale-yellowish or pale yellowish-red fine sand or loamy fine sand which becomes more distinctly yellowish red below a depth ranging

from 8 to 12 inches and grades, at an average depth of 12 or 15 inches, into (3) yellowish-red heavy fine sandy loam or sandy clay which extends to a depth of 36 or more inches. The partly weathered parent material consists of thick homogeneous beds of yellowish-red porous sandy clay.

This soil occurs on stream terraces from 10 to 25 feet above the levels of the first bottoms of rivers and some of the larger creeks of the county. It occupies prevailingly flat-topped benches or terraces, the surface of which is but slightly broken by draws or depressions. Areas are 2 miles southwest of Pleasant Hill Church, and 1 mile south of Persimmon Grove School.

This is among the most important of the terrace soils, and about 50 per cent of it is in cultivation. It is moderately acid in reaction, especially in the subsoil. It is devoted to the production of cotton, corn, cowpeas, and a wide range of the usual upland crops, including fruits and berries. Pastures are easily maintained. Wooded tracts support a good growth of mixed upland forest.

Drainage is good, and erosion is not a serious problem. This is a moisture-retentive soil and is one of the best general-purpose soils in the county. The terrace counterpart of Ruston fine sandy loam, it has about the same utilization as that soil but is somewhat more valuable, more easily worked, and more productive.

Land values range from $15 to $40 an acre.

Cahaba fine sandy loam, deep phase.—The deep phase differs from typical Cahaba fine sandy loam in that the pale-yellow fine sand or loamy fine surface soil is from 15 to 30 inches thick over the yellow, heavy fine sandy loam or sandy clay subsoil. In position, relief, surface configuration, reaction, and uses it is very similar to the typical soil. It is not extensive, but about 75 per cent of it is in cultivation.

Land values range from $15 to $40 an acre. The largest area is on a terrace near Blounts Lake.

LEAF FINE SANDY LOAM

Leaf fine sandy loam, the terrace equivalent of Kirvin fine sandy loam, closely resembles that soil. Under forest conditions it consists of a 2 or 3 inch layer of dark-gray fine sand, loamy fine sand, or very fine sandy loam underlain, to an average depth of 10 or 12 inches, by yellowish-gray fine sand, loamy fine sand, or very fine sandy loam beneath which is the heavy, plastic, red clay subsoil, rather high in colloids, which becomes mottled with yellow and gray, the mottles increasing in intensity with depth. In places the mottles are present in the upper part of the clay horizon as well as in the lower part. Some small areas in which the surface soil consists of yellowish-gray fine sand from 15 to 30 inches thick were included in mapping.

This soil occurs in association with other terrace soils. The principal areas are 2 miles west of Bernalda School, 1 mile north of Weavers Store, and near Naclina. About 15 per cent of the soil is in cultivation. The areas are nearly flat, for the most part, but are undulating in places. They occur on flat-topped benches. Surface

drainage is fairly good, but internal drainage is poor. The forested areas support a growth of pine, white, red, blackjack, and post oaks, gums, and hickories.

In cultivated fields, the soil is gray or dark-gray fine sand or loamy fine sand. The reaction is strongly acid, especially in the subsoil. Fair yields of cotton, corn, cowpeas, and oats are obtained. The relief favors easy cultivation, but this soil is not regarded as desirable for most crops.

Land values range from $5 to $20 an acre.

MYATT VERY FINE SANDY LOAM

A few scattered, depressed, very poorly drained areas on the terraces were mapped as Myatt very fine sandy loam. The soil resembles the Lufkin soils of the uplands in color, low position, and unfavorable, semiswampy moisture conditions. To a depth of 10 or 15 inches, the material is dark-gray loamy very fine sand or very fine sandy loam. This is underlain, to a depth of 36 inches, by gray or light-gray heavy loam, silty clay loam, or clay. The clay is sticky and plastic as a rule. The areas vary widely in texture, but no attempt was made to separate areas of different texture in mapping because of their very small extent and lack of agricultural significance.

None of this soil is in cultivation. The tree growth consists of willows, and water, pin, and willow oaks. This is a "crawfishy" soil and is wet most of the year. Water stands on it for considerable periods following rains. It has some little value for timber and such pasture as it affords.

OCHLOCKONEE FINE SAND

Ochlockonee fine sand has no weathered profile. The soil, to an average depth of 12 inches, is brown or yellowish-brown fine sand or loamy fine sand. This is underlain by yellow fine sand or fine sandy loam, continuous to a depth of 36 or more inches.

This soil is found in narrow strips along streams, especially in their upper reaches and particularly in sand-hill regions. The soil is, in fact, washed sand from the uplands, redeposited on the first bottoms at times of overflow. A few small areas along the immediate banks of Angelina River and Attoyac Bayou form parts of the natural levee.

The areas are nearly flat, and the surface is smooth in most places. Areas along overflow channels of the larger streams are cut up somewhat. Surface drainage is good in most places, and except in very wet seasons or in areas where the water table is high internal drainage is excellent.

This soil is moderately acid. Native vegetation consists of mixed hardwoods, principally white, red, post, and willow oaks; gums, hickories; pignuts; holly; dogwood; ironwood; elms; a large number of shrubs; and a good sod of wild grasses and native clovers.

This soil is subject to occasional overflow, and some areas are in need of underdrainage. Better-drained areas are reasonably productive but are less desirable for most crops than areas of the fine

sandy loam of this series. This soil is not so easily maintained in a high state of productivity as are the heavier members of the series, and it is less retentive of moisture and of fertilizers. It is, however, more productive, with the same fertilizer treatment and care, than the upland soils of similar texture.

This soil is used for the production of sweetpotatoes and potatoes, vegetables, forage crops, sugarcane, cotton, corn, and oats. It is also a fairly good hay and pasture soil. Cotton yields from one-quarter to 1 bale to the acre and corn from 15 to 30 bushels. Sugarcane produces from 150 to 250 gallons of sirup to the acre. Fertilizers are seldom used. On the older fields, from 100 to 150 pounds of superphosphate to the acre is applied to cotton.

As this soil occurs as bottom-land strips, land values are governed by values of adjacent uplands.

OCHLOCKONEE FINE SANDY LOAM

Ochlockonee fine sandy loam consists, to a depth of 10 or 12 inches, of brown or dark-brown loamy fine sand, fine sandy loam, or heavy fine sandy loam. This grades into interstratified heavy fine sandy loam or light clay loam. This material is solid yellow or yellowish-brown in the better-drained situations and dark brown or drab, mottled somewhat with rust brown, in depressions. As is true of all bottom-land soils, many textural variations occur in such small areas that they are unmappable on the scale used.

This soil occurs along most of the streams of the county and forms part of the natural levee of the rivers bordering the county. It is widely distributed and is important in connection with bottom-land pastures and, to some extent, with cultivated crops. About 25 per cent of its area is in cultivation. The relief is flat or nearly flat, with a slight slope in the direction of stream flow. Surface drainage is fairly good, but internal drainage is only moderately good. The soil is acid in reaction.

A large part of this soil is forested with sweetgum; black gum; white, red, post, willow, and water oaks; elms; maple; ironwood; and dogwood. There are a variety of bushes and shrubs and a strong sod of grasses and clovers, including carpet grass, bull grass, Bermuda grass, Johnson grass, Lespedeza, and bur clover.

This soil contains considerable organic matter and receives additions by sedimentation of washed materials from uplands at flood periods, when it is inundated except where protected by artificial levees.

The most important crops grown are corn, cotton, and sugarcane. In favorable years, corn yields from 25 to 40 bushels, cotton from one-half to 1 bale, and sugarcane from 150 to 250 gallons of sirup to the acre. Corn produces better than cotton under occasional high-water conditions. Superphosphate in small quantities is the only fertilizer commonly used. Moderate applications of complete fertilizers used under cotton in two recent dry seasons brought about a yield of more than a bale to the acre. The soil is widely used for cattle pasture.

Improvement of this soil is being effected along some of the larger creeks of the county by straightening the twisted and tortuous chan-

nels and building levees or dikes for protection from overflow. This is a very productive soil and is especially prized for corn and cane. Better-drained areas less liable to flood damage are largely planted to cotton. The value of this soil is influenced by the larger areas of upland soils with which it is sold.

OCHLOCKONEE VERY FINE SANDY LOAM

Ochlockonee very fine sandy loam, to a depth ranging from 8 to 12 inches, consists of dark-brown or brown very fine sandy loam or silt loam grading into yellowish-brown or brown silt loam, heavy silt loam, or dark-brown or drab clay loam or silty clay loam continuous to a depth of 36 or more inches. Some rust-brown mottles were seen in the deeper part of the subsoils of depressed or lower areas.

This bottom-land soil occurs in fairly large areas along the larger creeks. It occupies flat, smooth areas intermediate in position between the better-drained sandy Ochlockonee soils and the lower-lying Bibb soils. The principal areas are on the bottom of Loco Creek and Wanders Creek, on part of Lanana Creek bottom, and on the Angelina River bottoms west of Douglass. Many small areas occur elsewhere, mainly on the first bottoms of the larger creeks.

Drainage is fair. This soil suffers from inundation more than the sandy members of the series and needs levee protection in most of the creek bottoms. It is acid in reaction. The native vegetation consists of mixed hardwoods, including white, red, post, water, and willow oaks, gums, hickories, ironwood, elms, and a thick undergrowth and good sod.

About 25 per cent of this soil is in cultivation. Corn is the principal crop, and yields ranging from 25 to 50 bushels to the acre are obtained. Small acreages are planted to cotton, and good yields are obtained if the seasons are not wet or if the crops are undamaged by overflows. Levee protection is necessary on most areas for reasonable certainty in harvesting good crops. On an area near Nacogdoches, an orchard of pecan trees has been set out and is doing well. The soil is also used for pasture and bottom-land meadow.

This soil is perhaps the most fertile medium-textured soil in the county. Its fertility is not easily depleted. It is highly prized, and its occurrence on farms including other soils increases the general land value.

OCHLOCKONEE SILTY CLAY LOAM

Ochlockonee silty clay loam consists of brown or dark-brown clay loam or silty clay loam, 10 or 15 inches thick, underlain by dark-brown, brownish-gray, or drab silty clay or clay mottled in places with rust brown. It is, in a few places, interstratified with thin layers or lenses of very fine sandy loam or silt loam.

This is an important bottom-land soil occurring on the larger creek bottoms, on wide fairly well-drained flat stretches. It is slightly lower in position than the coarser members of this series, but it lies a little above the poorly drained soils of the Bibb series. Areas occur on Carisso Creek and on the bottoms of Angelina River and Attoyac Bayou. The surface of this soil is level and

smooth. A few low depressions consisting of Bibb clay loam were included in mapping. The soil is acid in reaction.

This soil is very subject to overflow. Drainage is slow, water tending to stand on the areas for a day or two after periods of high water. Internal drainage is sluggish.

Most of the Ochlockonee silty clay loam is in forest. Pin, water, willow, and overcup oaks; gums; elm; and ironwood are the principal trees. There is a rather heavy sod where the shade is not too dense. Switch cane grows well, providing winter grazing for cattle. About 20 per cent of the soil is in cultivation. Corn is the main crop, and a little cotton is grown. Corn yields from 20 to 40 bushels to the acre.

This is a favorite heavy bottom-land and meadow soil, and much of it is cleared or partly cleared. Some straightening of stream channels and diking against flood waters has been done. When such protection is given, the soil is suitable for raising cotton, corn, cowpeas, beans, and certain truck crops such as cabbage, cucumbers, and tomatoes. This soil is reasonably high in content of organic matter and is one of the most fertile soils in the county. It requires more intensive cultivation than the sandier soils of the series, in order to maintain a favorable structural condition. In many places it is difficult to establish good drainage conditions and protection from inundation.

HANNAHATCHEE FINE SANDY LOAM

Hannahatchee fine sandy loam is a bottom-land soil consisting of red or reddish-brown loamy fine sand, fine sandy loam, or very fine sandy loam, 10 or 12 inches thick, underlain by red or light-red heavy fine sandy loam or clay loam. Some associated Ochlockonee sandy soil is included in mapping, as the line of separation between the red and brown bottom soils is in many places indistinct. The red tint characteristic of this series of soils is derived from red materials washed from uplands, largely from soils of the Nacogdoches series.

This soil is of small extent in the county, being found on the Moss Creek bottom in the vicinity of Melrose, in the upper reaches of Carisso Creek, and along other small tributaries in the red-land districts. The soil is nearly level and is fairly smooth. It is subject to overflow, but drainage and internal water movement are good when the flood waters have subsided. The soil is acid in reaction.

About 50 per cent of this soil is in cultivation. The native vegetation is like that found on the sandy Ochlockonee soils. Corn and cotton are the principal crops grown. Corn yields from 20 to 40 bushels to the acre and cotton from one-half to 1 bale. Protection against inundation by flood waters is needed, and some farmers are building dikes for this purpose. This is a productive soil, is easily tilled, and is particularly adapted to corn, cotton, cane, and pasture grasses.

BIBB FINE SANDY LOAM

The surface soil of Bibb fine sandy loam is gray or dark-gray loamy fine sand, fine sandy loam, or very fine sandy loam, 10 or 15

inches thick, conspicuously mottled with yellow, reddish, or rust brown to the surface. The subsoil, to a depth of 36 or more inches, is light-gray heavy fine sandy loam or clay loam, also mottled with yellow or rust brown.

This "crawfishy" soil is too low and too poorly drained to be of any agricultural value. It is not extensive, being mapped along the upper Naconiche Creek and two of its small tributaries, and in the bottoms of Angelina River and Attoyac Bayou near Salt Lake.

The native forest is of gum, overcup oak, pin oak, and water oak, bottom-land hickories, and water-loving shrubs and small trees. There is scarcely any ground cover of grasses or switch cane. The soil is water-logged most of the year and is deeply inundated at flood periods. Its principal use is for the production of timber adapted to low swampy soils.

BIBB CLAY LOAM

The surface soil of Bibb clay loam consists of dark-brown or grayish-brown clay loam or silty clay loam, 10 or 15 inches thick, conspicuously mottled with yellow, orange, or rust brown to the surface. The subsoil is gray or light-gray silty clay or clay, similarly mottled and continuing to a depth of 36 or more inches.

This soil is extensive on the wide bottoms of Angelina River and Attoyac Bayou. Its commonest occurrence is in back valley positions in long areas bordering the upland or terrace soils and lying between them and the natural levees of the rivers. Where the rivers have not built up levees, Bibb clay loam extends to the channels in many places. The areas are flat and smooth, but in places are interrupted by sloughs or old channels. The soil is covered deeply at flood times, the watermarks on trees being from 4 to 10 feet above the ground level. Great quantities of driftwood, fallen trees, and slashings from lumbering operations have accumulated on areas of this soil. This is a "crawfishy" soil.

The native timber is overcup oak, water elm, gums, some cypress, bitter swamp pecans, and some hickories. (Pl. 4, B.) Some palmetto was seen on this soil near Salt Lake. There is no appreciable grass cover, except in open places and in small areas where the drainage is better than typical.

None of this soil is in cultivation and it has no present agricultural value. It is very acid. Its principal utilization is for the growing of hardwoods, for scant range pasture, and for the fattening of hogs on mast derived from the native oaks.

SUMMARY

Nacogdoches County is in the east-central part of Texas. It has a land area of 978 square miles, or 625,920 acres.

The relief of the county is gently rolling, rolling, or hilly. Elevations range from about 250 to 600 feet above sea level. Angelina River and Attoyac Bayou, which form the south, east, and west boundaries of the county, receive all the drainage waters. The county has good railroad facilities and is well supplied with public roads, which are well maintained.

Sixty per cent of the area of the county is in farms, and approximately half the total in farms is improved land. Nearly one-third of the improved land in farms is devoted to cotton and about one-third to corn. Cowpeas, sorgo, oats, and peanuts are other important forage crops. Some peaches, pears, figs, and berries are produced. Early tomatoes and watermelons are being raised in increasing quantities for shipment to outside markets. Dairy cattle and hogs, poultry, and range cattle are raised in rather large numbers.

The use of commercial fertilizers is increasing, as is the more general adoption of methods of alteration or rotation of crops for soil-improvement purposes and for plant-disease control.

Sufficient farm labor is available, but there is little floating labor. In 1920, 52.4 per cent of the farms were operated by owners and 47.5 per cent by tenants. The average value of land in farms in that year was $21.92 an acre.

The soils of the county are typical of the interior gulf coastal plain. Upland, terrace, and bottom soils are represented. Nearly all the upland, terrace, and better-drained bottom soils have sandy-textured surface soils, but a considerable proportion of the bottom soils are of clayey texture.

The most extensive upland soils of the area belong to the Norfolk, Orangeburg, Ruston, Nacogdoches, and Kirvin series. The terrace soils are members of the Kalmia, Cahaba, Leaf, and Myatt series. On the bottom lands, the Ochlockonee, Hannahatchee, and Bibb series are represented. The most important agricultural soils are the fine sandy loam of the Ruston and the fine sandy loam, gravelly fine sandy loam, and clay loam of the Nacogdoches series.

Nacogdoches County has large areas of undeveloped agricultural land, a considerable part of which is suited to diversified agriculture. The county is situated in the shortleaf pine timber belt, and cleared lands tend to revert to timber by natural reseeding. All nonagricultural lands will produce more or less valuable merchantable lumber.

Land values are comparatively low, marketing and transportation facilities are good, and educational, environmental, and living conditions are, in general, excellent. Nacogdoches County thus offers attractive opportunities for the new settler.

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[PUBLIC RESOLUTION—No 9]

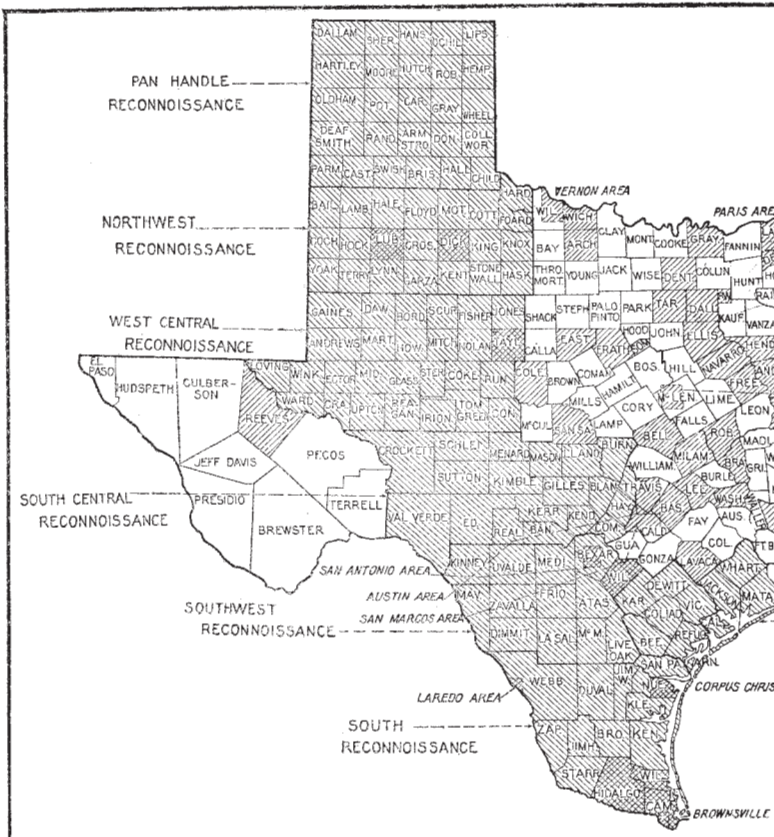
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided,* That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils, and on July 1, 1927, the Bureau of Soils became a unit of the Bureau of Chemistry and Soils.]



Areas surveyed in Texas, shown by shading

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BUREAU OF CHEMISTRY AND SOILS
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A. G. McCALL, CHIEF, SOIL INVESTIGATIONS
CURTIS F. MARBUT, IN CHARGE SOIL SURVEY

SOIL MAP
NACOGDOCHES COUNTY
TEXAS

TEXAS AGRICULTURAL EXPERIMENT STATION
B. YOUNGBLOOD, DIRECTOR

LEGEND

Bibb fine sandy loam — Bm	Kirvin clay loam — Kc	Nacogdoches fine sandy loam — Nf	Ochlockonee silty clay loam — Oc
Bibb clay loam — Bc	Kalmia fine sand — Ka	Nacogdoches gravelly clay loam — Na	Orangeburg fine sandy loam — Of
Bowie fine sandy loam — Bf	Kalmia fine sandy loam — Kl	Nacogdoches clay loam — Nc	Of — Deep phase
Cahaba fine sandy loam — Cf	Kl — Deep phase	Norfolk fine sand — Ns	Ruston fine sand — Rf
Cf — Deep phase	Kl — Rolling phase	Norfolk fine sandy loam — Nl	Ruston fine sandy loam — Rs
Greenville fine sandy loam — Gf	Leaf fine sandy loam — Lf	Nl — Deep phase	Rs — Deep phase
Hannahatchee fine sandy loam — Hf	Lufkin loam — Ll	Ochlockonee fine sand — Os	Rs — Gravelly phase
Kirvin fine sandy loam — Kf	Myatt very fine sandy loam — My	Ochlockonee fine sandy loam — Ol	Sumter clay — Sc
Kf — Deep phase	Nacogdoches gravelly fine sandy loam — Ng	Ochlockonee very fine sandy loam — Ov	Wilson clay loam — Wc

CONVENTIONAL SIGNS

CULTURE (Printed in black)
- City or Village, Roads, Buildings, Wharves, Jetties, Breakwaters, Levee, Lighthouse, Fort
- Secondary roads and Trails
- Railroads, Steam and Electric
- Bridges, Ferry
- R.R. crossings, Tunnel
- Ford, Dam
- School or Church, Cemeteries
- Mine or Quarry, Mine dumps, Made land
- Bluff, Escarpment, Rock outcrop and Triangulation station
- Stony and Gravelly areas
- Soil boundaries
- Boundary lines (State, County, City or Village, Land Grant, Civil Township, Reservation)
- U.S. township and section lines

RELIEF (Printed in brown or black)
- Contours, Depression contours
- Prominent Hills, Mountain Peaks
- Sand Wash, and Sand dunes
- Shore and Low water line, Sandbar

DRAINAGE (Printed in blue)
- Streams
- Lakes, Ponds, Intermittent lakes
- Intermittent streams
- Springs, Canals and Ditches, Flumes
- Swamp, Salt marshes
- Submerged marsh, Tidal flats

The above signs are in current use on the soil maps of this series, but may appear in some maps of earlier dates.

Hugh H. Bennett, Inspector, District 4.
Soils surveyed by B. H. Hendrickson, in charge, and R. E. Devereux, U. S. Department of Agriculture, and E. H. Templin, Texas Agricultural Experiment Station.

Scale 1 inch = 1 mile
1 0 1 2 3 4 Miles

Field Operations
Bureau of Soils
1925